



United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with the
Iowa Agriculture and
Home Economics
Experiment Station;
Cooperative Extension
Service, Iowa State
University; and Division of
Soil Conservation, Iowa
Department of Agriculture
and Land Stewardship

Soil Survey of Ringgold County, Iowa



How To Use This Soil Survey

General Soil Map

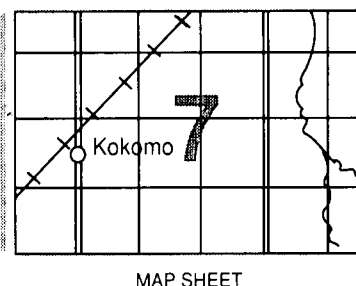
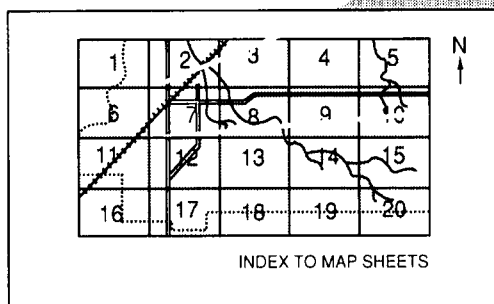
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

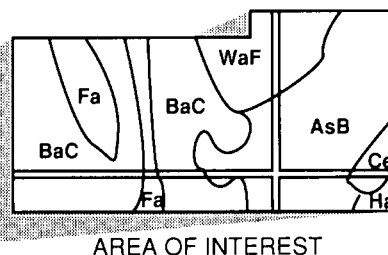
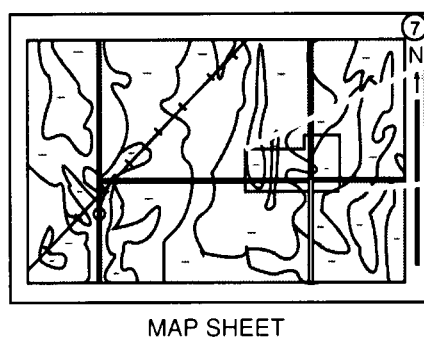
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1987. Soil names and descriptions were approved in 1987. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1987. This survey was made cooperatively by the Soil Conservation Service; the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship. It is part of the technical assistance furnished to the Ringgold County Soil and Water Conservation District. Funds appropriated by Ringgold County were used to defray part of the cost of the survey.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Typical area of the Gara-Armstrong-Pershing association.

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Preface

This soil survey contains information that can be used in land-planning programs in Ringgold County, Iowa. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Soil Survey of Ringgold County, Iowa

By Louis E. Boeckman, Soil Conservation Service

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United States Department of Agriculture, Soil Conservation Service, in cooperation with the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship

General Nature of the County

RINGGOLD COUNTY is in the south-central part of Iowa (fig. 1). It has an area of 344,320 acres, or 538 square miles. Mount Ayr is the county seat. It is in the center of the county, about 90 miles south of Des Moines.

This survey updates the soil survey of Ringgold County published in 1918 (6). It provides additional information and larger maps, which show the soils in greater detail.

Early History

The area now known as Ringgold County at one time was part of the Sac and Fox Indian tribal domain. The area was ceded to the U.S. Government in 1830. A number of Pottawattamie Indians remained in the county until 1855. The first settlers were the Charles H. Schoor family, which settled in the southeastern part of the county in 1844. The early settlers came mainly from Missouri, Illinois, Indiana, Ohio, and Kentucky. They made their living largely by hunting and trading. They built their homes along streams, where wood, water, and game could be readily obtained (3, 7).

As the population increased, settlements were made on the prairie lands and grain production and feeding of livestock became the principal kinds of farming. As early as 1855, the first county fair was held. Corn, hay and forage, wheat, and oats were the main crops. All of

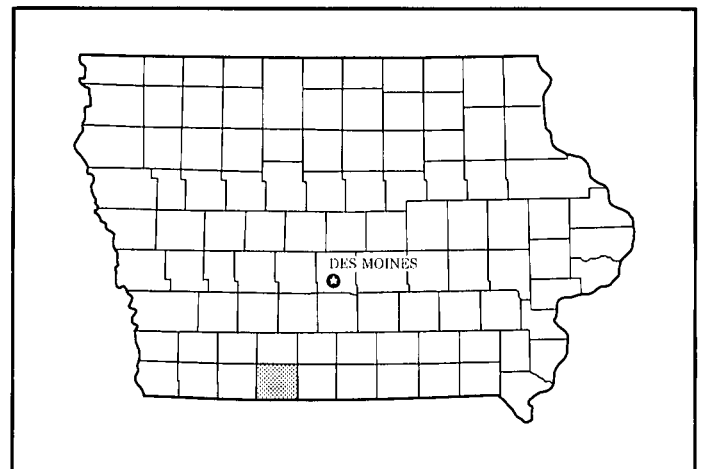


Figure 1.—Location of Ringgold County in Iowa.

these crops, except for wheat, were grown principally for subsistence. The surplus was sold. In 1880, a total of 68,857 acres was planted to corn. Livestock feeding was also an important industry at this time. In 1909, a total of 24,806 cattle and 58,089 hogs were sold or slaughtered in the county. The price of farmland in 1910 was between \$50 and \$125 per acre. Land rents for general farming were \$5 to \$8 per acre (20).

Ringgold County was officially established in 1847. It

was named in honor of Major Samuel Ringgold, one of the heroes of the Mexican War. In 1855, the Iowa State Legislature appointed commissioners to select a site for the county seat. A site near the center of the county was chosen. It was named Mount Ayr. Soon after the county seat was selected, an election of officers was held. In the spring of 1856, the first court house was built in Mount Ayr. The population of the county was 12,085 in 1880. It peaked at 15,325 in 1900. By 1980, it had decreased to 6,106.

Farming

Farms in Ringgold County, like those across the Midwest, have been increasing in size and decreasing in number (18, 24). The number of farms decreased from 984 in 1974 to 800 in 1983. The average size of the farms increased during this period from 334 to 424 acres. In 1983, the average size in Iowa was 293 acres.

Farm production in the county generally is mixed livestock and grain crops. Some corn is sold as a cash crop, but the amount sold varies from year to year, depending largely on the price of feeder cattle, the market for fattened cattle, the market for hogs, the cash price of corn, and the quality of the corn crop. In 1983, the acreage used for various grain crops in Ringgold County was as follows: corn for all purposes, 41,000 acres; oats, 15,500 acres; soybeans, 52,300 acres; and hay, 52,400 acres.

Beef cattle and hogs are the most extensively raised livestock in Ringgold County. In 1983, about 115,000 hogs, 6,100 grain-fed cattle, and 1,600 grain-fed sheep and lambs were marketed. According to a 1983 census, milk cows numbered 1,000 and beef cows numbered 8,800 in the spring and 7,600 in the fall.

Relief and Drainage

The original topography of Ringgold County was that of a loess-covered glacial till plain. This plain was greatly modified through the downcutting of streams by geologic erosion. This landscape shaping was greatly influenced by the glacial till that was exposed below the original loess-covered plain. The remnants of this plain occur as a series of stable loess-covered divides throughout the county. These nearly level to gently sloping divides are $\frac{1}{8}$ to $\frac{1}{2}$ mile wide. They become narrower in the southern part of the county. They are bordered by moderately sloping loess-covered side slopes at the upper end of drainageways.

Also extending from the stable divides are slightly lower, moderately sloping loess-covered ridges about 100 to 400 feet wide. Below these ridges are moderately sloping and strongly sloping soils that formed in a paleosol weathered from glacial till. Below

these soils are strongly sloping and moderately steep soils that formed in glacial till. In the progression from the stable divides to more dissected areas near the larger drainageways, the moderately sloping loess-covered ridges become narrower and the mantle of loess thinner until the paleosol is exposed on the ridges. These areas have longer, steeper side slopes of glacial till. They commonly include less sloping soils that formed in valley fill on south- and east-facing slopes along the larger drainageways and streams. The nearly level or level bottom land is $\frac{1}{8}$ to $\frac{3}{8}$ mile wide (5).

The highest elevation in Ringgold County, about 1,280 feet above sea level, is on a few upland divides along the northern county line. The elevation of these divides decreases in the southern part of the county. The lowest elevation in the county, about 970 feet above sea level, is in an area where the East Fork of the Grand River enters Missouri. The larger stream valleys are commonly 110 to 170 feet below the adjacent upland divides.

All of Ringgold County is in the watershed of the Missouri River. The western part of the county is drained by the Platte River, the central part by the Grand River and its east and middle forks, the eastern part by Lotts Creek and the West Fork of Big Creek, and the extreme northeast corner by the Thompson River. Streams generally flow in a south to southwesterly direction.

The soils on the nearly level upland divides are poorly drained. The soils that formed in loess on gently sloping upland ridges are moderately well drained in the western one-fourth of the county and somewhat poorly drained in the eastern part. The moderately sloping soils that formed in loess range from poorly drained to moderately well drained in the western fourth of the county and are somewhat poorly drained in the eastern part. The paleosols range from poorly drained to moderately well drained. Hillside seeps form between the moderately sloping soils that formed in loess and the paleosols.

The strongly sloping to steep soils that formed in glacial till are well drained. Generally, the soils on bottom land are poorly drained or very poorly drained and are subject to flooding and ponding. They are drained by tile drains and surface drains.

Natural Resources

Soil is the most important natural resource in the county. It provides a growing medium for marketable crops and for the grass grazed by livestock. Another natural resource is a limestone quarry in the southern part of the county (7).

In most areas of Ringgold County, the water supply usually is adequate for domestic uses and for watering livestock. Glacial till and alluvium are water-bearing sources for shallow wells (8). Glacial till aquifers are not always reliable because the soils are somewhat impermeable and rainfall tends to run off the surface rather than be absorbed into the ground. Alluvial aquifers are shallow and are dependent on local rainfall for recharge. Climatic records show patterns of spotty rainfall. The deeper glacial aquifers and the bedrock aquifers at a depth of a few hundred feet are highly mineralized. Wells should be monitored periodically for ground-water pollutants. Mount Ayr obtains its water from the 75-acre Lock Ayr municipal reservoir. Approximately one-sixth of the county is served by the Twelve-Mile reservoir in Union County, which is directly north of Ringgold County. Another rural water supply is Sun Valley Lake, which is in Ringgold County. Water for livestock is supplied mainly by approximately 2,295 farm ponds in the county.

Wildlife also is a natural resource in the county. The county provides opportunities for hunting ring-necked pheasant, bobwhite quail, waterfowl, turkey, squirrel, rabbit, coyote, racoon, and white-tailed deer. The many farm ponds are inhabited by bass, bluegill, crappie, catfish, and bullhead. The streams are inhabited by catfish. Fur-bearing animals are trapped along drainageways and creeks. The county has about 2,320 acres of state-owned wildlife areas.

Transportation Facilities

Two major highways serve Ringgold County. U.S. Highway 169 traverses the county from north to south, and State Highway 2 runs east and west. These highways intersect near the central part of the county, at Mount Ayr. Hard-surfaced county roads connect these highways to the smaller communities. All farms are along farm-to-market roads surfaced with crushed limestone. Mount Ayr has a small municipal airport.

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

Ringgold County is cold in winter. It is quite hot in summer but has occasional cool spells. Precipitation during the winter frequently occurs as snowstorms. During the warm months, when warm, moist air moves in from the south, the precipitation occurs chiefly as showers, which are often heavy. The total annual rainfall is normally adequate for corn, soybeans, and small grain.

Table 1 gives data on temperature and precipitation

for the survey area as recorded at Mount Ayr, Iowa, in the period 1951 to 1984. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 25 degrees F and the average daily minimum temperature is 16 degrees. The lowest temperature on record, which occurred at Mount Ayr on January 13, 1974, is -23 degrees. In summer, the average temperature is 73 degrees and the average daily maximum temperature is 84 degrees. The highest recorded temperature, which occurred at Mount Ayr on July 22, 1974, is 104 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 34.36 inches. Of this, about 24 inches, or 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 20 inches. The heaviest 1-day rainfall on record was 5.85 inches at Mount Ayr on July 8, 1988. Thunderstorms occur on about 50 days each year.

Tornadoes and severe thunderstorms strike occasionally. These storms are local in extent and of short duration and result in sparse damage in narrow belts. Hailstorms occur in scattered small areas at times during the warmer part of the year.

The average seasonal snowfall is about 20 inches. The greatest snow depth at any one time during the period of record was 23 inches. On the average, 3 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 13 miles per hour, in spring.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a

discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to

other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been

observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

1. Nira-Sharpsburg-Shelby Association

Gently sloping to moderately steep, moderately well drained and well drained, silty and loamy soils formed in loess and glacial till; on uplands and stream benches

This association consists of soils on moderately wide, convex ridgetops and short, convex side slopes. The landscape is undulating to hilly. Slopes range from 2 to 18 percent.

This association makes up about 14 percent of the county. It is about 23 percent Nira soils, 21 percent Sharpsburg soils, 14 percent Shelby soils, and 42 percent soils of minor extent (fig. 2).

The moderately sloping, moderately well drained Nira soils are on the lower, narrow ridges and short, convex side slopes in the uplands. The gently sloping and moderately sloping, moderately well drained Sharpsburg soils are on ridges and short, convex side slopes in the uplands and on stream benches. The strongly sloping and moderately steep, well drained Shelby soils are on ridges and side slopes in the uplands that are dissected by small drainageways.

Typically, the surface layer of the Nira soils is very dark gray and very dark grayish brown, friable silty clay loam about 11 inches thick. The subsoil is mottled silty clay loam about 39 inches thick. The upper part is dark brown and dark yellowish brown and is friable and firm, the next part is grayish brown and light brownish gray and is firm, and the lower part is light brownish gray and firm. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam.

Typically, the surface layer of the Sharpsburg soils is black, friable silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 9 inches thick. The subsoil to a depth of 60 inches is silty clay loam. The upper part is dark brown and friable; the next part is brown and grayish brown, mottled, and firm; and the lower part is grayish brown, mottled, and friable.

Typically, the surface layer of the Shelby soils is very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some dark brown and yellowish brown subsoil material with the surface layer. The subsoil is clay loam about 30 inches thick. The upper part is dark brown and yellowish brown and is friable, the next part is yellowish brown and firm, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam.

The minor soils in this association are the Adair, Clarinda, Clearfield, Ely, Lamoni, Macksburg, and Zook soils. Adair soils formed in a red, clayey paleosol weathered from glacial till. They are on narrow ridges and short, convex side slopes upslope from the Shelby soils. Clarinda soils are poorly drained and are in upland coves near the head of drainageways. They formed in a gray, clayey paleosol weathered from glacial till. Clearfield soils are poorly drained and are at the head of drainageways downslope from the Sharpsburg and Nira soils. They formed in loess 3 to 5 feet deep over a gray, clayey paleosol. Ely and Zook soils formed in silty alluvium and have a thick, dark surface soil. Ely soils are somewhat poorly drained and are on foot slopes. Zook soils are poorly drained and are in drainageways. Lamoni soils are somewhat poorly

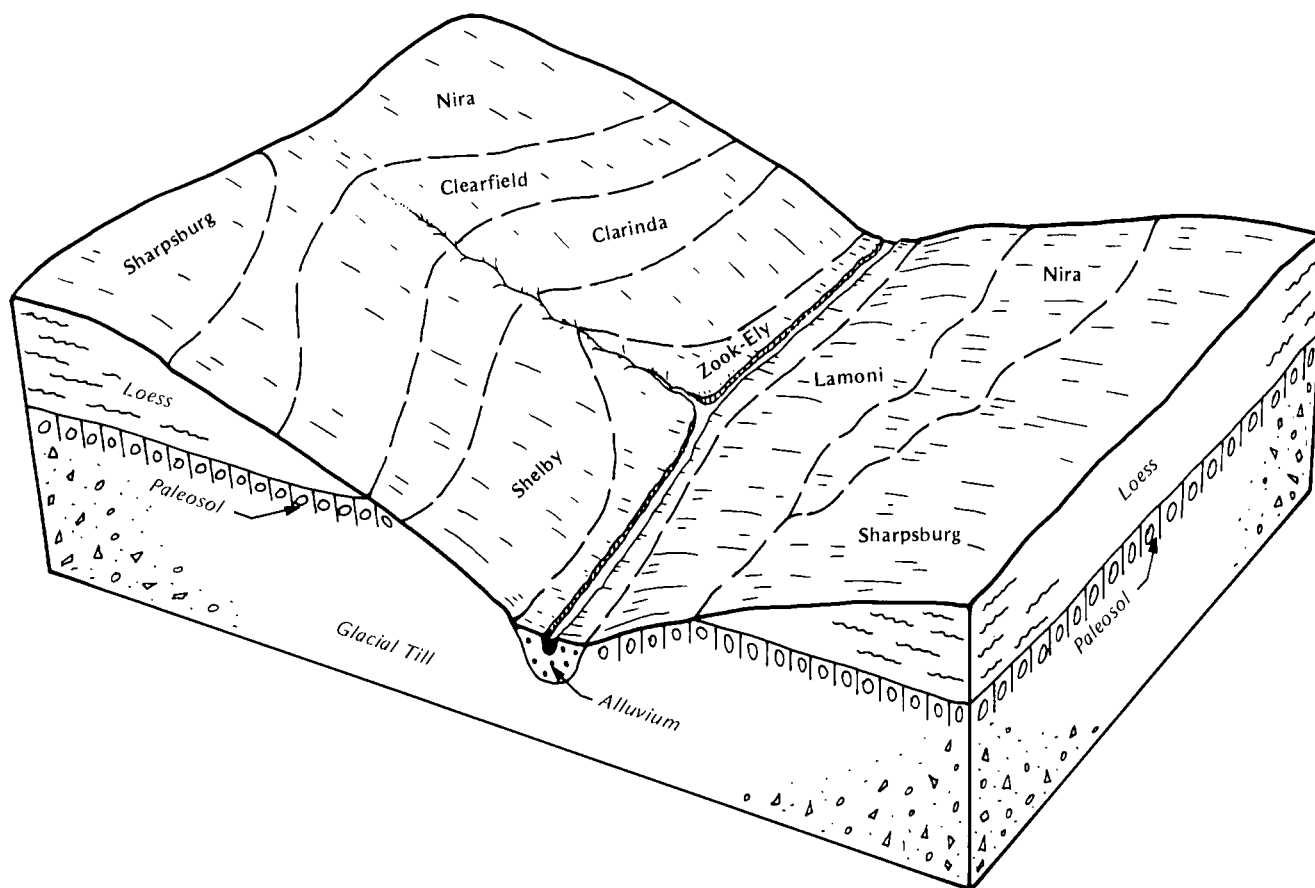


Figure 2.—Typical pattern of soils and parent material in the Nira-Sharpsburg-Shelby association.

drained and are on convex side slopes near the head of drainageways. They formed in a grayish and brownish, clayey paleosol weathered from glacial till. Macksburg soils are similar to the Sharpsburg soils, but they are somewhat poorly drained and are on broad upland divides and convex ridgetops upslope from the Sharpsburg soils.

Most of the gently sloping and moderately sloping soils on uplands in this association are used for cultivated crops. The strongly sloping and moderately steep soils are used for permanent pasture and hay. Many ponds are in the moderately steep areas. They help to control erosion and provide water for livestock. The main enterprises are growing cash-grain crops and hay and raising cow-calf herds.

Corn, soybeans, small grain, and hay grow well or moderately well on the gently sloping and moderately sloping soils. The strongly sloping soils are suited to corn and moderately well suited to small grain, hay, and pasture. The available water capacity is high. Organic matter content is moderate. The main management

needs are measures that control erosion, prevent the formation of gullies, and maintain fertility.

2. Gara-Armstrong-Ladoga Association

Moderately sloping to steep, well drained and moderately well drained, silty and loamy soils formed in glacial till, a paleosol derived from glacial till, and loess; on uplands

This association consists of soils on ridges and side slopes. The landscape is gently rolling to steep. Slopes range from 5 to 25 percent.

This association makes up about 11 percent of the county. It is about 25 percent Gara and similar soils, 21 percent Armstrong and similar soils, 18 percent Ladoga and similar soils, and 36 percent soils of minor extent.

The well drained Gara soils are on narrow ridges and convex side slopes that are dissected by many small drainageways. The moderately well drained Armstrong soils are on the lower, narrow ridges and short, convex side slopes. The moderately well drained Ladoga soils are on ridges and short, convex side slopes.

Typically, the surface layer of the Gara soils is very dark grayish brown, friable loam about 6 inches thick. Plowing has mixed some dark grayish brown subsoil material with the surface layer. The subsoil is clay loam about 30 inches thick. The upper part is dark grayish brown and friable, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is mottled yellowish brown and strong brown, calcareous clay loam.

Typically, the surface layer of the Armstrong soils is very dark grayish brown and dark gray, friable clay loam about 8 inches thick. Plowing has mixed some dark yellowish brown subsoil material with the surface layer. The subsoil to a depth of about 60 inches is clay loam. The upper part is dark yellowish brown and friable; the next part is mottled yellowish brown, dark grayish brown, grayish brown, and red and is firm; and the lower part is mottled strong brown, grayish brown, and light brownish gray and is firm.

Typically, the surface layer of the Ladoga soils is very dark gray, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 30 inches thick. The upper part is brown, mottled, friable silty clay loam; the next part is brown, mottled, firm silty clay; and the lower part is mottled yellowish brown, grayish brown, and strong brown, friable and firm silty clay loam. The substratum to a depth of about 60 inches is mottled light brownish gray, strong brown, and yellowish brown silty clay loam.

The minor soils in this association are the Bucknell, Ely, Humeston, Nira, Olmitz, and Zook soils. Bucknell soils are somewhat poorly drained and are in upland coves and on side slopes upslope from the Gara and Armstrong soils. They formed in a grayish and brownish paleosol weathered from glacial till. Ely, Humeston, and Zook soils formed in alluvium in narrow drainageways and on toe slopes at the base of the steeper upland side slopes. Ely soils are somewhat poorly drained, and Humeston and Zook soils are poorly drained. Nira soils formed in loess on convex ridgetops and side slopes upslope from the Ladoga soils. Olmitz soils formed in loamy alluvium on foot slopes. They have a thick, dark surface soil.

Most of the moderately sloping areas in this association are used for cultivated crops. The strongly sloping to steep areas generally are used for hay and pasture. Some of the steep areas, however, are used as woodland or wildlife habitat. Many ponds are in the moderately steep and steep areas. They help to control erosion and provide water for livestock. The main enterprises are growing cash-grain crops and hay and raising cow-calf herds.

The moderately sloping soils are moderately well

suited to corn, soybeans, and small grain and are well suited to grasses and legumes for hay and pasture. Some of the soils are poorly suited to legumes because of the seasonal high water table. The strongly sloping soils are suited to corn and small grain but are better suited to grasses and legumes for hay and pasture. The moderately steep and steep soils are best suited to permanent pasture, woodland, and wildlife habitat. The available water capacity is high. Organic matter content is moderately low or moderate. The main management needs are measures that control erosion, prevent the formation of gullies, and maintain fertility.

3. Nodaway-Humeston-Wabash Association

Nearly level and gently sloping, moderately well drained, poorly drained, and very poorly drained, silty and clayey soils formed in alluvium; on bottom land along streams

This association consists of soils on bottom land and foot slopes along the major streams and tributaries. These soils are subject to flooding. The landscape is nearly level and undulating. Slopes range from 0 to 5 percent.

This association makes up about 8 percent of the county. It is about 37 percent Nodaway soils, 20 percent Humeston soils, 15 percent Wabash and similar soils, and 28 percent soils of minor extent (fig. 3).

The nearly level, moderately well drained Nodaway soils commonly are adjacent to the stream channels. The nearly level and undulating, poorly drained Humeston soils are along the major streams and on low, slightly concave foot slopes near the uplands. The nearly level, very poorly drained Wabash soils are along the major streams and smaller tributaries.

Typically, the surface layer of the Nodaway soils is very dark gray, friable silt loam about 7 inches thick. The substratum to a depth of about 60 inches is stratified very dark gray, dark grayish brown, and grayish brown silt loam.

Typically, the surface layer of the Humeston soils is very dark gray, friable silty clay loam about 11 inches thick. The subsurface layer is dark gray, mottled, friable silt loam about 14 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is dark gray, friable silty clay loam, and the lower part is very dark gray, firm silty clay.

Typically, the surface layer of the Wabash soils is black, firm silty clay about 8 inches thick. The subsurface layer also is black, firm silty clay. It is about 12 inches thick. The subsoil to a depth of about 60 inches is black, mottled, very firm silty clay.

The minor soils in this association are the Ackmore, Carlow, Kennebec, Nevin, Sharpsburg, and Zook soils. Ackmore soils are on the first bottoms on flood plains

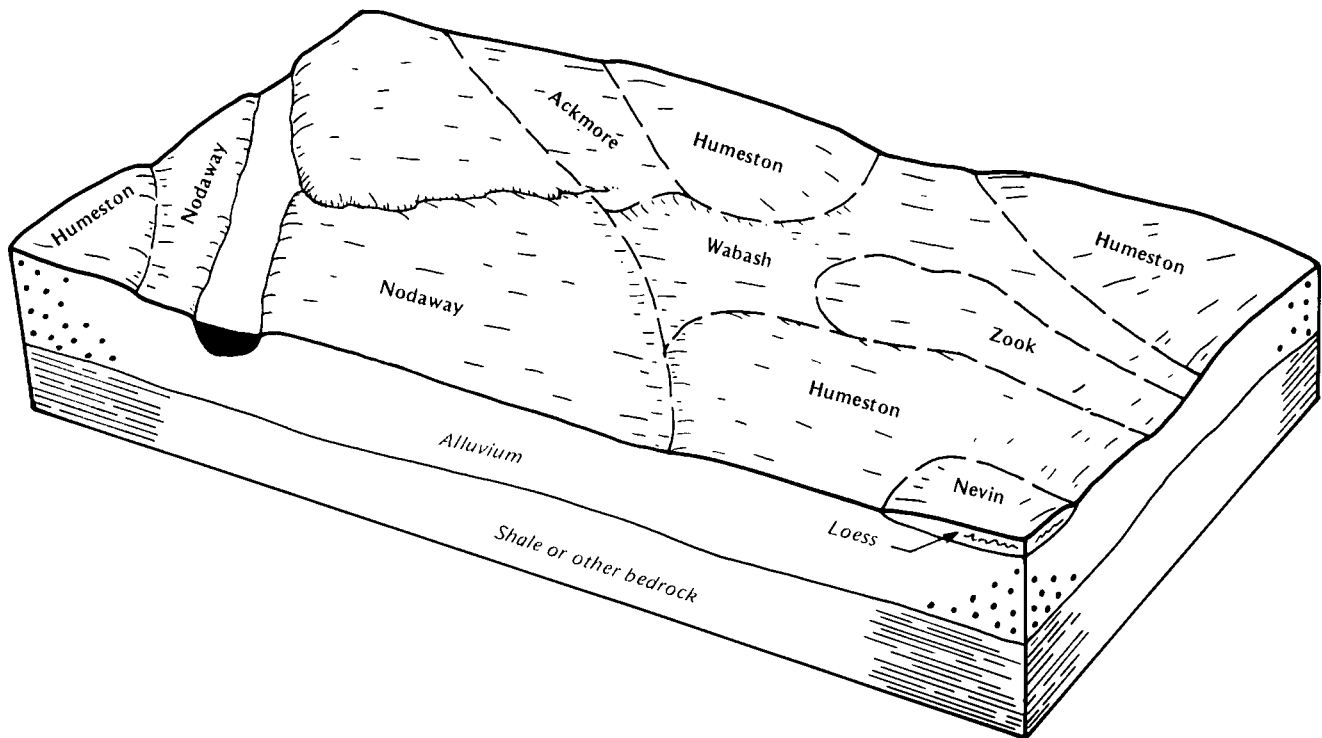


Figure 3.—Typical pattern of soils and parent material in the Nodaway-Humeston-Wabash association.

and are somewhat poorly drained. They are moderately permeable. Carlow soils are similar to the Wabash soils, but they have a thinner dark surface soil. They are on second bottoms on flood plains and are very poorly drained. They are very slowly permeable. Kennebec soils are on the first bottoms on flood plains and are moderately well drained. They are moderately permeable and have a thick, dark surface soil. Nevin soils are somewhat poorly drained and are on stream terraces. Sharpsburg soils formed in loess. They are moderately well drained and are on high stream benches. Zook soils are on first and second bottoms and are poorly drained. They are slowly permeable, do not have a subsurface layer, and contain less clay than the Wabash soils.

Most of this association is used for cultivated crops, small grain, or hay. Areas characterized by meandering stream channels and narrow stream valleys are used as pasture or habitat for woodland wildlife. The main enterprise is growing cash-grain crops.

The Nodaway soils are well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The Wabash and Humeston soils are suited to corn, soybeans, and small grain and to grasses for hay and pasture. They are poorly suited to legumes because of the seasonal high water table. All

of the soils are occasionally flooded or frequently flooded. The available water capacity is moderate to very high. Organic matter content is moderately low to high. Permeability is moderate to very slow. The main management needs are measures that improve drainage in areas of the Wabash and Humeston soils, protect the soils from floodwater, and maintain fertility. The soils can be drained by surface drains if adequate outlets are available. Diversions, levees, and channel improvement help to control floodwater and the runoff from adjacent areas.

4. Gara-Armstrong-Pershing Association

Gently sloping to steep, well drained to somewhat poorly drained, loamy and silty soils formed in glacial till, a paleosol derived from glacial till, and loess; on uplands and stream benches

This association consists of soils on long, narrow, convex ridgetops and dissected side slopes. The landscape is nearly level to steep. Slopes range from 2 to 25 percent.

This association makes up about 38 percent of the county. It is about 28 percent Gara and similar soils, 27 percent Armstrong and similar soils, 10 percent

Pershing and similar soils, and 35 percent soils of minor extent (fig. 4).

The well drained Gara soils are on narrow ridges and convex side slopes that are dissected by many small drainageways. The moderately well drained Armstrong soils are on the lower, narrow ridges and short, convex side slopes. The moderately well drained or somewhat poorly drained Pershing soils are on ridges and short, convex side slopes in the uplands.

Typically, the surface layer of the Gara soils is very dark grayish brown, friable loam about 6 inches thick. Plowing has mixed some dark grayish brown subsoil material with the surface layer. The subsoil is clay loam about 30 inches thick. The upper part is dark grayish brown and friable, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is mottled yellowish brown and strong brown, calcareous clay loam.

Typically, the surface layer of the Armstrong soils is very dark grayish brown and dark gray, friable clay loam about 8 inches thick. Plowing has mixed some dark yellowish brown subsoil material with the surface layer. The subsoil to a depth of about 60 inches is clay loam.

The upper part is dark yellowish brown and friable; the next part is mottled yellowish brown, dark grayish brown, grayish brown, and red and is firm; and the lower part is mottled strong brown, grayish brown, and light brownish gray and is firm.

Typically, the surface layer of the Pershing soils is very dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is brown, friable silty clay loam; the next part is dark grayish brown and grayish brown, firm silty clay; and the lower part is light brownish gray, firm and friable silty clay loam.

The minor soils in this association are the Arispe, Bucknell, Grundy, Humeston, Mystic, Nodaway, Olmitz, and Zook soils. Arispe and Grundy soils are on convex ridgetops and short, convex side slopes in the uplands. They are upslope from the Pershing soils. They formed in loess under prairie grasses. Bucknell soils are similar to the Armstrong soils. They formed in a grayish and brownish, clayey paleosol weathered from glacial till. They are in upland coves and on side slopes upslope

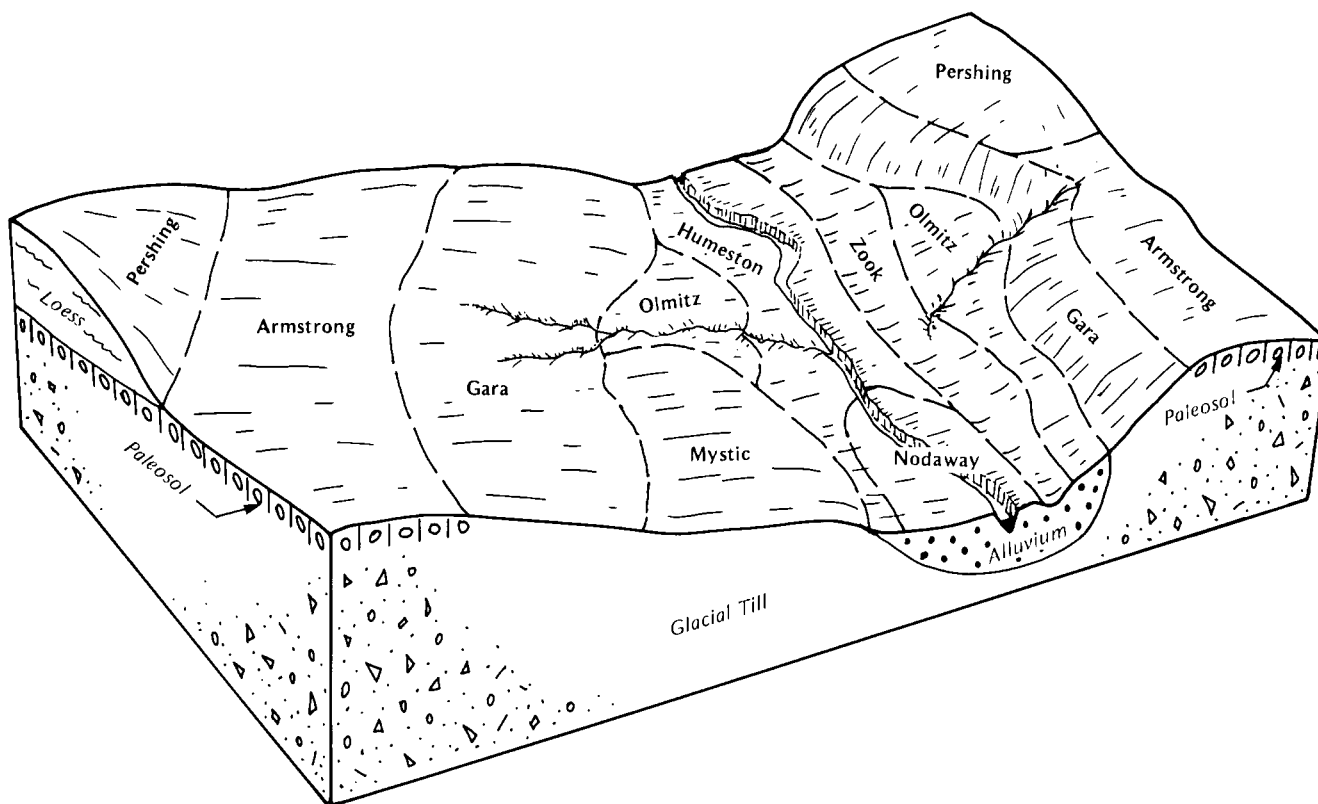


Figure 4.—Typical pattern of soils and parent material in the Gara-Armstrong-Pershing association.

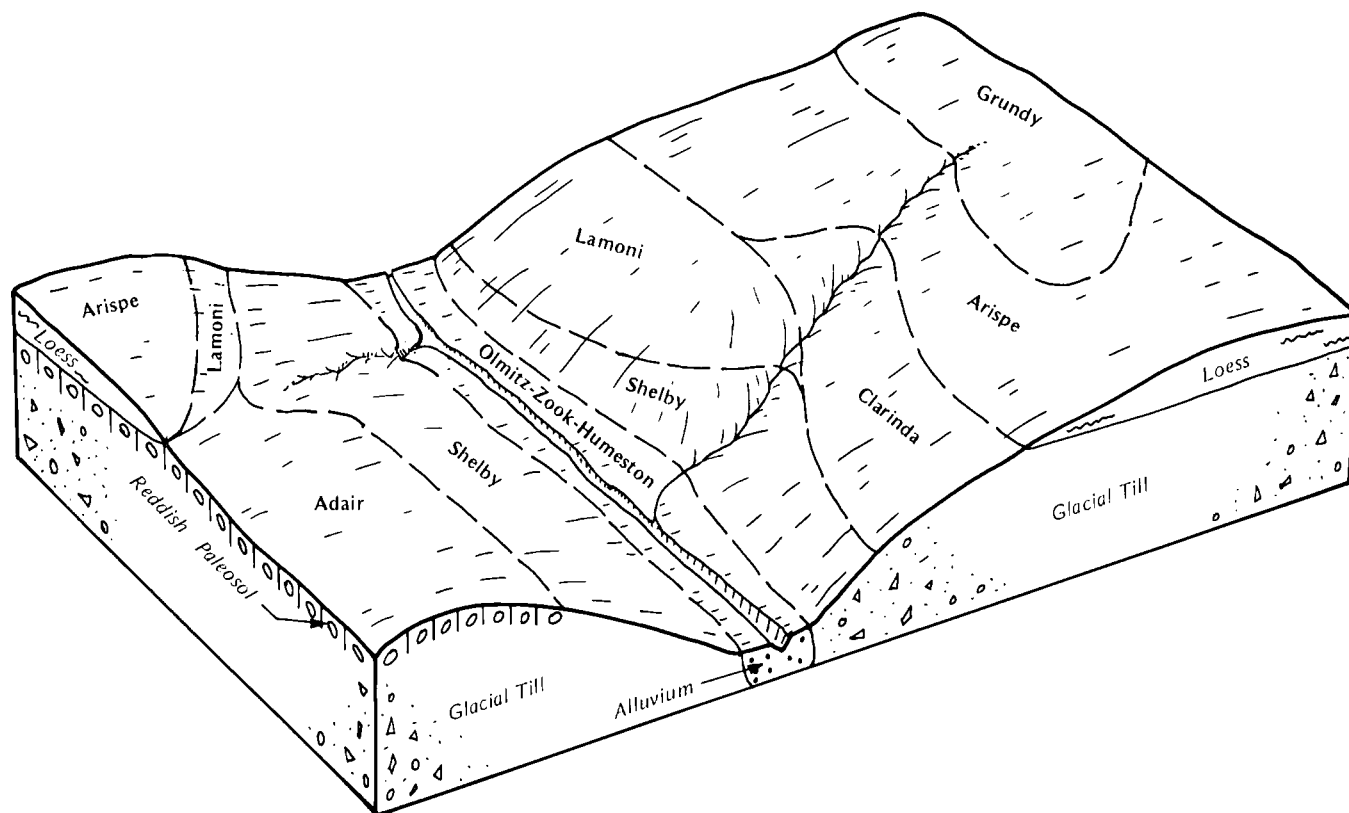


Figure 5.—Typical pattern of soils and parent material in the Arispe-Shelby-Lamoni association.

from the Gara and Armstrong soils. Humeston and Zook soils are poorly drained and formed in silty alluvium in drainageways. They have a thick, dark surface soil. Mystic soils are on narrow, convex ridgetops and the short, convex or slightly concave side slopes of stream benches and foot slopes on uplands. They are downslope from the Gara and Armstrong soils. They are stratified. Nodaway soils are moderately well drained and are along stream channels. They formed in recent stratified alluvium. Olmitz soils have a thick, dark surface soil. They formed in loamy alluvium on foot slopes.

Most of the gently sloping and moderately sloping soils on uplands in this association are used for hay or cultivated crops. Most of the strongly sloping to steep soils are used as permanent pasture, woodland, or wildlife habitat. Many ponds are in the steep areas. They help to control erosion and provide water for livestock. The main enterprises are growing cash-grain crops and hay and raising cow-calf herds.

The gently sloping and moderately sloping soils are suited to corn, soybeans, small grain, and hay. Legumes can be grown for hay if a drainage system is

installed. The available water capacity is moderate or high. Organic matter content is low or moderate. The main management needs are measures that control erosion, prevent the formation of gullies, and maintain fertility.

5. Arispe-Shelby-Lamoni Association

Moderately sloping to moderately steep, somewhat poorly drained and well drained, silty and loamy soils formed in loess, glacial till, and a paleosol derived from glacial till; on uplands

This association consists of soils on convex ridgetops and side slopes that are dissected by small drainageways in the uplands. The landscape is gently rolling to hilly. Slopes range from 5 to 18 percent.

This association makes up about 27 percent of the county. It is about 26 percent Arispe soils, 19 percent Shelby soils, 16 percent Lamoni soils, and 39 percent soils of minor extent (fig. 5).

The somewhat poorly drained Arispe soils are on ridges and short side slopes near the head of drainageways. The well drained Shelby soils are on

ridges and side slopes that are dissected by small drainageways. The somewhat poorly drained Lamoni soils are on short, convex side slopes near the head of drainageways and on narrow ridges at the lower elevations.

Typically, the surface layer of the Arispe soils is black, friable silty clay loam about 6 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 4 inches thick. The subsoil to a depth of 60 inches is mottled silty clay loam. The upper part is dark grayish brown and friable, the next part is grayish brown and firm, and the lower part is light olive gray and firm.

Typically, the surface layer of the Shelby soils is very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some dark brown and yellowish brown subsoil material with the surface layer. The subsoil is clay loam about 30 inches thick. The upper part is dark brown and yellowish brown and is friable, the next part is yellowish brown and firm, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam.

Typically, the surface layer of the Lamoni soils is very dark gray, friable silty clay loam about 6 inches thick. Plowing has mixed some dark grayish brown subsoil material with the surface layer. The subsoil extends to a depth of about 60 inches. It is firm. The upper part is dark grayish brown and grayish brown, mottled clay; the next part is light gray, mottled clay; and the lower part is mottled light gray and yellowish brown clay loam.

The minor soils in this association are the Adair, Clarinda, Grundy, Humeston, Olmitz, and Zook soils. Adair soils formed in a red, clayey paleosol weathered from glacial till. They are on the lower, narrow ridges and short, convex side slopes upslope from the Shelby soils. Clarinda soils are poorly drained and are in coves at the head of drainageways. They formed in a gray, clayey paleosol weathered from glacial till. Grundy soils formed from loess. They are on convex ridgetops and side slopes upslope from the Arispe soils. Humeston and Zook soils are poorly drained and formed in alluvium in drainageways. They have a thick, dark surface soil. Olmitz soils also have a thick, dark surface soil. They formed in loamy alluvium on foot slopes.

Most of the gently sloping soils on uplands in this association are used for cultivated crops. The moderately sloping and strongly sloping soils generally are used for hay or pasture but in some areas are used for cultivated crops. Most of the moderately steep soils are used as permanent pasture or wildlife habitat. Many ponds are in the moderately steep areas. They help to control erosion and provide water for livestock. The

main enterprises are growing cash-grain crops and hay and raising cow-calf herds.

Corn, soybeans, small grain, and hay grow well on the gently sloping soils. The moderately sloping and strongly sloping soils are suited to corn and soybeans and are moderately well suited to small grain and to grasses and legumes for hay and pasture. The moderately steep soils are suited to grasses and legumes for hay and are well suited to pasture. The available water capacity is high. Organic matter content is moderate. The main management needs are measures that control erosion, prevent the formation of gullies, and maintain fertility.

6. Lindley-Keswick Association

Moderately sloping to very steep, well drained and moderately well drained, loamy soils formed in glacial till and a paleosol derived from glacial till; on uplands

This association consists of soils on narrow ridges, short, convex side slopes, and convex valley side slopes. The landscape is gently rolling to very steep. Slopes range from 5 to 40 percent.

This association makes up about 1 percent of the county. It is about 40 percent Lindley soils, 39 percent Keswick soils, and 21 percent soils of minor extent.

The well drained Lindley soils are on narrow ridges and valley side slopes. The moderately well drained Keswick soils are on the lower ridges and short, convex side slopes.

Typically, the surface layer of the Lindley soils is very dark gray, friable loam about 3 inches thick. The subsurface layer is grayish brown, friable loam about 7 inches thick. The subsoil is clay loam about 30 inches thick. The upper part is yellowish brown and friable, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam.

Typically, the surface layer of the Keswick soils is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is brown, friable silt loam about 6 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is brown, friable clay loam; the next part is reddish brown and strong brown, mottled, firm clay and strong brown, mottled, firm clay loam; and the lower part is mottled yellowish brown, light brownish gray, and strong brown, firm clay loam.

The minor soils in this association are the Armstrong, Humeston, Olmitz, Weller, and Zook soils. Armstrong soils are in positions on the landscape similar to those of the Keswick soils. They formed under native vegetation of mixed grasses and deciduous trees. They are eroded. Humeston and Zook soils are poorly drained and formed in alluvium in drainageways. They

have a thick, dark surface soil. Olmitz soils also have a thick, dark surface soil. They formed in loamy alluvium on foot slopes and in drainageways. Weller soils are on convex ridgetops and the upper side slopes. They are upslope from the Keswick soils. They formed in loess under native vegetation of deciduous trees.

The moderately sloping soils in this association are used for woodland, permanent pasture, or hay. The strongly sloping to very steep soils are used as woodland, permanent pasture, or wildlife habitat. Most of the wooded areas in Ringgold County are in this association. Many ponds are in the deep, gullied drainageways on uplands. They provide water for livestock and wildlife. The main enterprises are raising cow-calf herds and logging.

The moderately sloping soils are poorly suited to corn, soybeans, and small grain but are suited to grasses for hay and pasture. The strongly sloping to very steep soils are suited to trees, pasture, and wildlife habitat. The available water capacity is high. Organic matter content is moderately low or low. The main management needs are measures that help to control erosion, prevent the formation of gullies, and maintain fertility. In some areas the slope restricts the use of logging equipment. In areas that have been clearcut, erosion is a severe hazard unless a protective plant cover is established and maintained.

7. Grundy-Haig Association

Nearly level and gently sloping, somewhat poorly drained and poorly drained, silty soils formed in loess; on uplands

This association consists of soils on broad upland divides, convex ridgetops, and short side slopes in the uplands. The landscape is nearly level and undulating. Slopes range from 0 to 5 percent.

This association makes up about 1 percent of the county. It is about 46 percent Grundy soils, 31 percent

Haig soils, and 23 percent soils of minor extent.

The somewhat poorly drained Grundy soils are on convex ridgetops and short, convex side slopes. The poorly drained Haig soils are on broad upland divides.

Typically, the surface layer of the Grundy soils is black, friable silty clay loam about 10 inches thick. The subsurface layer also is black, friable silty clay loam. It is about 6 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark grayish brown, friable silty clay loam; the next part is dark grayish brown and grayish brown, mottled, firm silty clay; and the lower part is light brownish gray, firm silty clay loam.

Typically, the surface layer of the Haig soils is black, friable silty clay loam about 8 inches thick. The subsurface layer is black, friable silty clay about 11 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled and firm. The upper part is very dark gray silty clay, and the lower part is light brownish gray silty clay and silty clay loam.

The minor soils in this association are the Arispe and Edina soils. Arispe soils are on short, convex side slopes in coves at the head of drainageways and on narrow ridges downslope from the Grundy soils. They contain less clay than the Grundy soils. Edina soils are in slight depressions on broad upland divides. They are characterized by a more abrupt increase in content of clay between the surface soil and subsoil than the Haig soils. Also, they have a lighter colored subsurface layer.

Most of this association is used for row crops, small grain, or hay. The main enterprise is growing cash-grain crops or hay. The soils are well suited or moderately well suited to corn, soybeans, small grain, and hay. They are suited to pasture. The available water capacity is high. Organic matter content is moderate or high. Permeability is slow. The main management needs are measures that improve drainage, help to control erosion, and maintain fertility. A surface drainage system is needed in the nearly level areas.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Shelby clay loam, 9 to 14 percent slopes, moderately eroded, is a phase of the Shelby series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Olmitz-Zook-Humeston complex, 0 to 5 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named.

Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, sand and gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

13B—Olmitz-Zook-Humeston complex, 0 to 5 percent slopes. These nearly level and gently sloping soils are in narrow drainageways that extend from the uplands to small streams. The moderately well drained Olmitz and poorly drained Humeston soils are on low, slightly concave foot slopes. The poorly drained Zook soil is on bottom land near the stream channels. The Zook soil is occasionally flooded, and the Humeston soil is subject to rare flooding. Areas are long and narrow and range from 10 to more than 100 acres in size. They are about 40 percent Olmitz soil, 30 percent Zook soil, and 20 percent Humeston soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Olmitz soil has a surface layer of black and very dark brown, friable loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable loam about 20 inches thick. The subsoil to a depth of about 60 inches is clay loam. The upper part is dark brown and friable; the next part is brown, mottled, and friable; and the lower part is brown, mottled, and friable and firm.

Typically, the Zook soil has a surface layer of black, friable silty clay loam about 9 inches thick. The subsurface layer is about 27 inches thick. The upper part is black, friable silty clay loam; the next part is black, firm silty clay; and the lower part is very dark gray, firm silty clay. The subsoil is dark gray, firm silty clay about 14 inches thick. The substratum to a depth of about 60 inches is gray, mottled silty clay. In places the surface layer is silt loam and has a low content of organic matter.

Typically, the Humeston soil has a surface layer of very dark gray, friable silty clay loam about 11 inches thick. The subsurface layer is dark gray, mottled, friable silt loam about 14 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is dark gray and gray, friable silty clay loam, and the lower part is very dark gray, firm silty clay.

Included with these soils in mapping are small areas of the moderately well drained, stratified Nodaway soils near the stream channels. These soils have a lower organic matter content than the Olmitz, Zook, and Humeston soils. They make up about 10 percent of the unit.

Permeability is moderate in the Olmitz soil, slow in the Zook soil, and very slow in the Humeston soil. Runoff is medium on the Olmitz soil and slow on the Zook and Humeston soils. The Zook soil has a seasonal high water table within a depth of 3 feet, and the Humeston soil has one within a depth of 1 foot. The available water capacity is high in the Olmitz and Humeston soils and moderate in the Zook soil. The shrink-swell potential is high in the Zook and Humeston soils. The content of the organic matter is about 3 to 4 percent in the surface layer of the Olmitz and Humeston soils and 5 to 7 percent in the surface layer of the Zook soil. The supply of available phosphorus is very low in the Olmitz soil and medium in the Zook and Humeston soils. The supply of available potassium is very low in the subsoil of the Olmitz and Humeston soils and low in the Zook soil. Tilth is good in the Olmitz soil and fair in the Zook and Humeston soils. All three soils tend to puddle if worked when wet.

Most areas are managed along with the adjacent soils as pasture, cropland, or hayland. If drained and protected from runoff, the Humeston soil is suited to corn, soybeans, and small grain and the Olmitz and Zook soils are moderately well suited. Many areas are dissected by waterways that cannot be crossed by machinery. Terraces, contour stripcropping, a system of conservation tillage that leaves crop residue on the surface, grassed waterways, and contour farming on the soils upslope reduce the hazard of gully erosion on these soils and minimize the hazard of flooding. Tile drainage is needed in the grassed waterways. The tile

may not work satisfactorily, however, because of the very slow or slow permeability in the Zook and Humeston soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soils or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

The Olmitz and Zook soils are well suited to grasses for hay, and the Humeston soil is moderately well suited. The Olmitz soil is well suited to pasture, and the Zook and Humeston soils are suited. The Olmitz soil is suited to legumes, but the Humeston and Zook soils are poorly suited because of the seasonal high water table and the flooding. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When pasture or hayland in areas of the Olmitz soil is renovated, preparing a seedbed and applying cultural measures on the contour help to control water erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIw.

23C—Arispe silty clay loam, 5 to 9 percent slopes.

This moderately sloping, somewhat poorly drained soil is on short, convex side slopes in coves at the head of drainageways and on narrow ridges at the slightly lower elevations in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is black, friable silty clay loam about 6 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 4 inches thick. The subsoil to a depth of about 60 inches is mottled silty clay loam. The upper part is dark grayish brown and friable, the next part is grayish brown and firm, and the lower part is light olive gray and firm. In some places, the surface layer is thicker and the subsoil contains more clay. In other places it is thinner because of erosion.

Included with this soil in mapping are small areas of Clarinda and Lamoni soils. These soils formed in a gray, clayey paleosol that weathered from glacial till. They are on the lower parts of the side slopes and are seepy and wet during the spring. Preparing a seedbed is more difficult on these soils than on the Arispe soil. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Arispe soil. The available water capacity is high. Runoff is medium. The seasonal high water table is at a depth of 2 to 4 feet. The shrink-swell potential is high. The surface layer typically contains about 3 to 4 percent organic matter. The subsoil typically has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, water erosion is a severe hazard. If an intensive row cropping system is used, a combination of conservation tillage, which leaves crop residue on the surface, terraces, contour farming, grassed waterways, contour stripcropping, and crop rotations that include grasses and legumes helps to prevent excessive soil loss. If rainfall is above normal, the soil becomes seasonally wet and seepy. A combination of tile drainage and terraces is needed to improve the timeliness of fieldwork during wet periods in spring and to control erosion. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed, applying cultural measures, and interseeding on the contour help to control erosion.

The land capability classification is IIIe.

23C2—Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained soil is on short, convex side

slopes in coves at the head of drainageways and on narrow ridges at the slightly lower elevations in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 40 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. Plowing has mixed some of the dark grayish brown subsoil with the surface layer. The subsoil to a depth of about 60 inches is mottled silty clay loam. The upper part is dark grayish brown, the next part is grayish brown, and the lower part is light olive gray and firm. In places, the surface layer is thicker and the subsoil contains more clay.

Included with this soil in mapping are small areas of Clarinda and Lamoni soils. These soils formed in a gray, clayey paleosol that weathered from glacial till. They are on the lower parts of the side slopes. Also included are the severely eroded Arispe soils, which generally are in areas on shoulder slopes $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. More intensive management is needed to maintain fertility on these soils than on the less eroded Arispe soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Arispe soil. The available water capacity is high. Runoff is medium. The seasonal high water table is at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil typically has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, water erosion is a severe hazard. If an intensive row cropping system is used, a combination of conservation tillage, which leaves crop residue on the surface, terraces, contour farming, grassed waterways, contour stripcropping, and crop rotations that include grasses and legumes helps to prevent excessive soil loss. If rainfall is above normal, the soil becomes seasonally wet and seepy. A combination of tile drainage and terraces is needed to improve the timeliness of fieldwork during wet periods in spring and to control erosion. More intensive management is needed to maintain fertility on this soil than on the less eroded Arispe soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay (fig. 6) and is suited to pasture. It is suited to legumes if



Figure 6.—Hay in an area of Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded. A crop rotation that includes grasses and legumes helps to control erosion on this soil.

an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed, applying cultural measures, and interseeding on the contour help to control erosion.

The land capability classification is IIIe.

24D—Shelby clay loam, 9 to 14 percent slopes.

This strongly sloping, well drained soil is on ridges and side slopes in the uplands. The landscape is dissected by small drainageways. Slopes typically are short. Areas range from 5 to 20 acres in size. Most are irregular in shape, but some are long and narrow.

Typically, the surface layer is very dark grayish brown, friable clay loam about 8 inches thick. The subsurface layer is dark brown, friable clay loam about 4 inches thick. The subsoil is clay loam about 26 inches thick. The upper part is brown and dark yellowish brown, mottled, and friable; the next part is yellowish brown and firm; and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with this soil in mapping are some small areas of Adair and Lamoni soils. These soils have a clayey subsoil. They are on the upper parts of side

slopes and on shoulder slopes. They make up about 10 percent of the unit.

Permeability is moderately slow in the Shelby soil. Runoff is rapid. The available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are used for pasture or hay. Some are cultivated. In most areas this soil is managed along with the adjacent soils. It is suited to corn and small grain. If cultivated crops are grown, water erosion is a hazard. It can be controlled in row cropped areas by a system of conservation tillage that leaves crop residue on the surface and by crop rotations that include meadow crops. Conservation measures are needed on this soil and on the soils upslope. Some areas have slopes that are long enough and smooth enough to be farmed on the contour and terraced. Terrace cuts should not expose the underlying firm glacial till, which is low in fertility. A combination of conservation measures is commonly needed to control water erosion. Good tilth generally can be easily maintained. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses and legumes for hay and is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed, applying cultural measures, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

24D2—Shelby clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on ridges and side slopes in the uplands. The landscape is dissected by small drainageways. Slopes typically are short. Areas range from 5 to 20 acres in size. Most are irregular in shape, but some are long and narrow.

Typically, the surface layer is very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some of the dark brown and yellowish brown subsoil with the surface layer. The subsoil is clay loam about 30 inches thick. The upper part is dark brown and yellowish brown and is friable, the next part is yellowish brown and firm, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of severe erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with this soil in mapping are some small areas of Adair and Lamoni soils. These soils have a clayey subsoil. They are on the upper parts of the side slopes and on shoulder slopes. Also included are the severely eroded Shelby soils, which generally are in scattered areas about ½ acre in size. More intensive management is needed to maintain fertility on these soils than on the less eroded Shelby soils. The included soils make up about 10 percent of the unit.

Permeability is moderately slow in the Shelby soil. Runoff is rapid. The available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Some areas are cultivated, and some are used as pasture. In most areas this soil is managed along with the adjacent soils. It is suited to corn and small grain. If cultivated crops are grown, water erosion is a hazard. It can be controlled in row cropped areas by a system of conservation tillage that leaves crop residue on the surface and by crop rotations that include meadow crops. Conservation measures are needed on this soil and on the soils upslope. Some areas have slopes that are long enough and smooth enough to be farmed on the contour and terraced. Terrace cuts should not expose the subsoil, which is low in fertility. If the subsoil is exposed, topsoil is needed. A combination of conservation measures is commonly needed to control water erosion. More intensive management is needed to maintain fertility on this soil than on the less eroded Shelby soils. Tilth generally can be easily maintained. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses and legumes for hay and is moderately well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed, applying cultural measures, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

24E—Shelby clay loam, 14 to 18 percent slopes.

This moderately steep, well drained soil is on narrow, convex side slopes in the uplands. The landscape is dissected by small drainageways. Areas generally are long and narrow and are parallel to intermittent streams. They range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray, friable clay loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable clay loam about 3 inches thick. The subsoil is yellowish brown, mottled, firm clay loam about 30 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In places the surface layer is thinner because of erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with this soil in mapping are small areas of Adair and Lamoni soils. These soils have a clayey subsoil. They are on shoulder slopes. They make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Shelby soil. Runoff is rapid. The available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are used for hay or pasture. Some areas formerly were cultivated. This soil is poorly suited to cultivated crops. If cultivated crops are grown, water erosion is a severe hazard. Row crops should be grown only in a rotation that includes several years of meadow crops. In years when row crops are grown, water erosion can be controlled by a system of conservation tillage that leaves crop residue on the surface and by contour stripcropping. Conservation tillage and contour farming increase the rate of water infiltration and help to control runoff. Grassed waterways help to prevent the

formation of gullies. The soil is poorly suited to terracing because of the slope. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses and legumes for hay and is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed, applying cultural measures, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IVe.

24E2—Shelby clay loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on narrow ridges and convex side slopes in the uplands. The landscape is dissected by small drainageways. Areas generally are long and narrow and are parallel to intermittent streams. They range from 5 to 20 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some of the yellowish brown subsoil with the surface layer. The subsoil is clay loam about 28 inches thick. The upper part is yellowish brown, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of severe erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with this soil in mapping are small areas of Adair and Lamoni soils. These soils have a clayey subsoil. They are on shoulder slopes. Also included are the severely eroded Shelby soils, which generally are in scattered areas about ½ acre in size. More intensive management is needed to maintain fertility on these soils than on the less eroded Shelby soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Shelby soil. Runoff is rapid. The available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has

a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are used as pasture. This soil is poorly suited to cultivated crops. It is better suited to small grain. If cultivated crops are grown, water erosion is a severe hazard. Row crops should be grown only in a rotation that includes several years of meadow crops. In years when row crops are grown, erosion can be controlled by a conservation tillage system that leaves crop residue on the surface and by contour stripcropping. Conservation tillage and contour farming increase the rate of water infiltration and help to control runoff. Grassed waterways help to prevent the formation of gullies. The soil is poorly suited to terracing because the unfertile glacial till is too shallow. More intensive management is needed to maintain fertility on this soil than on the less eroded Shelby soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses and legumes for hay and is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed, applying cultural measures, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IVe.

54—Zook silty clay loam, 0 to 2 percent slopes.

This nearly level, poorly drained soil is on bottom land along the major streams and along the smaller tributaries. It is occasionally flooded. Areas are irregularly shaped and range from 10 to 400 acres in size.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is about 27 inches thick. The upper part is black, firm silty clay loam, and the lower part is black and very dark gray, firm silty clay. The subsoil is black, firm silty clay about 14 inches thick. The substratum to a depth of about 60 inches is gray, mottled silty clay. In places the surface layer is silt loam and has a low content of organic matter. In some areas the subsurface layer is

silt loam and is lighter in color. In other areas the subsoil contains less clay.

Permeability and runoff are slow. The seasonal high water table is within a depth of 3 feet. The available water capacity is moderate. The shrink-swell potential is high. The content of organic matter is about 5 to 7 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. If drained and protected from flooding, this soil is moderately well suited to corn, soybeans, and small grain. Tile drainage generally can work satisfactorily, but it should be supplemented by other drainage measures. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. Fall plowing improves the timeliness of fieldwork but increases the susceptibility to soil blowing. Leaving the plowed surface rough and alternating plowed and unplowed strips help to control soil blowing. Chisel plowing, which leaves crop residue on the surface, also helps to control soil blowing. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table and the flooding. Management may be difficult because the soil is poorly drained and occasionally flooded. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands and dikes or levees along the major stream channels may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the extent of ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIw.

54+—Zook silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land along the major streams and on first bottoms along the smaller tributaries. It is occasionally flooded. Areas are irregularly shaped and range from 10 to 50 acres in size.

Typically, the surface layer is stratified dark grayish brown and very dark gray, friable silt loam about 14 inches thick. The subsurface layer is black silty clay loam about 36 inches thick. It is friable in the upper part and firm in the lower part. The subsoil to a depth of about 60 inches is very dark gray, firm silty clay. In places the lower part of the subsurface layer is silt loam and is lighter in color.

Permeability and runoff are slow. The seasonal high water table is within a depth of 3 feet. The available water capacity is moderate. The shrink-swell potential is high. The content of organic matter is about 2 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. If drained and protected from flooding, this soil is moderately well suited to corn, soybeans, and small grain. Tile drainage generally can work satisfactorily, but it should be supplemented by other drainage measures. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. Fall plowing improves the timeliness of fieldwork but increases the susceptibility to soil blowing. Leaving the plowed surface rough and alternating plowed and unplowed strips help to control soil blowing. Chisel plowing, which leaves crop residue on the surface, also helps to control soil blowing. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table and the flooding. Management may be difficult because the soil is poorly drained and occasionally flooded. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands and dikes or levees along the major

stream channels may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the extent of ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is 1lw.

54B—Zook silty clay loam, 2 to 5 percent slopes.

This gently sloping, poorly drained soil is on low, slightly concave foot slopes and alluvial fans. It is directly downslope from soils on side slopes that formed in loess or valley fill and upslope from broad, nearly level bottom land. Areas generally are long and narrow and range from 4 to 10 acres in size.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is about 27 inches thick. The upper part is black, friable silty clay loam; the next part is black, firm silty clay; and the lower part is very dark gray, firm silty clay. The subsoil is dark gray, firm silty clay about 14 inches thick. The substratum to a depth of about 60 inches is gray, mottled silty clay. In places the surface layer is stratified silt loam. In some areas the subsurface layer is lighter in color and contains less clay.

Permeability is slow. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is moderate. The shrink-swell potential is high. The content of organic matter is about 5 to 7 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. If drained, this soil is moderately well suited to corn, soybeans, and small grain. Tile drainage generally can work satisfactorily, but it should be supplemented by other drainage measures. In many areas diverting runoff from the soils upslope can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. If cultivated crops are grown, water erosion is a slight hazard. Contour stripcropping and a system of conservation tillage that leaves crop residue on the surface help to prevent excessive soil loss. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning

crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table. Management may be difficult because the soil is poorly drained. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIw.

65D—Lindley loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on narrow, convex ridgetops and valley side slopes in the uplands. The landscape commonly is dissected by small drainageways. Slopes typically are short. Areas generally are irregular in shape and range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray, friable loam about 3 inches thick. The subsurface layer is grayish brown, friable loam about 7 inches thick. The subsoil is yellowish brown clay loam about 30 inches thick. The upper part is friable, and the lower part is mottled and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam.

Included with this soil in mapping are small areas of the moderately well drained Keswick soils. These soils formed in a red, clayey paleosol. They are on narrow interfluvies and shoulder slopes on the upper parts of the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Lindley soil. The available water capacity is high. Runoff is rapid. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil typically has a low supply of available phosphorus and a very low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture or woodland. This

soil is poorly suited to corn and small grain. If row crops are grown, water erosion is a severe hazard. These crops should be grown only to establish a pasture. Conservation measures are needed on this soil and on the soils upslope. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. If terraces are constructed, the cuts should not expose the underlying firm glacial till, which is low in fertility. If the subsoil is exposed, revegetating is difficult, even in areas that are topdressed with surface soil material. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime is needed if it has not been applied in the past 3 to 4 years.

This soil is suited to grasses and legumes for hay and is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed, applying cultural measures, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

Many areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

65E—Lindley loam, 14 to 18 percent slopes. This moderately steep, well drained soil is on convex valley side slopes in the uplands. The landscape commonly is dissected by small drainageways and gullies. Areas generally are long and narrow and are parallel to intermittent streams. They range from 5 to 30 acres in size.

Typically, the surface layer is very dark gray, friable loam about 3 inches thick. The subsurface layer is grayish brown, friable loam about 7 inches thick. The subsoil is yellowish brown clay loam about 29 inches thick. The upper part is friable, the next part is mottled and firm, and the lower part is firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer

is thicker and darker. In other places, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with this soil in mapping are small areas of the moderately well drained Keswick soils. These soils formed in a red, clayey paleosol. They are on narrow interfluvial and shoulder slopes on the upper parts of the landscape. They make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Lindley soil. The available water capacity is high. Runoff is rapid. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil typically has a low supply of available phosphorus and a very low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as permanent pasture or woodland. This soil is generally unsuited to cultivated crops because of the slope and a severe hazard of water erosion. It is better suited to pasture, trees, and wildlife habitat.

This soil is poorly suited to grasses and legumes for hay and is moderately well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed and applying cultural measures on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

Many areas support native hardwoods. This soil is suited to trees. Carefully locating logging trails or roads and laying out the trails or roads on the contour or nearly on the contour can reduce the hazard of erosion. Because of the slope, operating equipment is hazardous. Special equipment can be used. Caution is needed in operating the equipment. Seedlings survive and grow well.

The land capability classification is VIe.

65G—Lindley loam, 18 to 40 percent slopes. This steep and very steep, well drained soil is on convex or plane valley side slopes in the uplands. The landscape commonly is dissected by gullies. Areas generally are long and narrow and are parallel to intermittent streams. They range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 2 inches thick. The subsurface layer is dark grayish brown and grayish brown, friable loam about 8 inches thick. The subsoil is yellowish brown clay loam about 28 inches thick. The upper part is friable, the next part is firm and mottled, and the lower part is firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer is thicker and darker. In other places, the subsoil is thinner and the calcareous substratum is closer to the surface.

Permeability is moderately slow. Runoff is very rapid. The available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as woodland. Some are used as pasture. This soil is suited to trees. It generally is unsuitable for cultivated crops and hay and is poorly suited to pasture because of the slope and a severe hazard of water erosion.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet causes surface compaction and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture. When the pasture is renovated, using special equipment and applying cultural measures on the contour help to control erosion. Brush control is needed in most pastured areas because of overgrazing and low or moderate forage production.

Most areas support native hardwoods. This soil is suited to trees. Carefully locating logging trails and roads and laying out the trails or roads on the contour reduce the hazard of water erosion. Because of the slope, operating equipment is somewhat hazardous. Special equipment can be used. Caution is needed in operating the equipment. Seedlings do not survive well on this soil. Planting a large number of seedlings at close intervals can help to achieve a desirable stand density.

The land capability classification is VIIe.

69C—Clearfield silty clay loam, 5 to 9 percent slopes. This moderately sloping, poorly drained soil is on short, convex side slopes in coves at the head of

drainageways and on narrow ridges at the lower elevations in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 35 acres in size.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is very dark gray, mottled, friable silty clay loam about 5 inches thick. The subsoil is mottled silty clay loam about 34 inches thick. The upper part is dark gray and firm, the next part is gray and light brownish gray, and the lower part is dark gray. A paleosol of gray, firm silty clay is between depths of 48 and 60 inches. In some places depth to the gray, clayey paleosol is more than 5 feet. In other places the slope is more than 9 percent. In some areas the surface soil is thinner because of erosion.

Included with this soil in mapping are small areas of Clarinda soils. These soils formed in a gray, clayey paleosol that weathered from glacial till. They are on the lower side slopes near the head of drainageways. They make up about 10 to 15 percent of the unit.

Permeability is moderately slow in the Clearfield soil. Runoff is medium. The available water capacity is high. The seasonal high water table is at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Many areas are used for pasture or hay. Some areas are cultivated. This soil is suited to corn, soybeans, and small grain. Because the soil is poorly drained and remains wet and seepy for long periods, a combination of tile drainage and terraces is needed to improve the timeliness of fieldwork and to control water erosion. Deferring tillage during wet periods minimizes compaction and improves tilth. If cultivated crops are grown year after year, water erosion is a severe hazard. It can be controlled in intensively cultivated areas by a combination of conservation measures, such as a conservation tillage system that leaves crop residue on the surface, winter cover crops, contour stripcropping, grassed waterways, terraces, and crop rotations that include grasses and legumes. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table. Management may be difficult because the soil is poorly drained. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Terraces on the adjacent soils in the uplands may be needed to protect

this soil from erosion. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed and interseeding on the contour help to control erosion.

The land capability classification is Illw.

69C2—Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, poorly drained soil is on short, convex side slopes in coves at the head of drainageways and on narrow ridges at the lower elevations in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. Plowing has mixed some of the grayish brown subsoil with the surface layer. The subsoil is silty clay loam about 30 inches thick. The upper part is grayish brown and friable; the next part is grayish brown, mottled, and firm; and the lower part is gray, mottled, and firm. A paleosol of gray, firm silty clay is between depths of 36 and 60 inches. In some places depth to the gray, clayey paleosol is more than 5 feet. In other places the slope is more than 9 percent.

Included with this soil in mapping are small areas of Clarinda soils. These soils formed in a gray, clayey paleosol that weathered from glacial till. They are on the lower side slopes near the head of drainageways. Also included are the moderately well drained Nira soils, which are on the upper parts of the landscape. The included soils make up about 10 to 15 percent of the unit.

Permeability is moderately slow in the Clearfield soil. Runoff is medium. The available water capacity is high. The seasonal high water table is at a depth of 1 to 3 feet. The shrink-swell potential is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is poor. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain. Because the soil is poorly drained and remains wet and seepy for long periods, a combination of tile drainage and terraces is needed to control water erosion and to improve the timeliness of fieldwork. Deferring tillage during wet periods minimizes compaction and improves tilth. If cultivated crops are

grown year after year, water erosion is a severe hazard. It can be controlled in the intensively row cropped areas by a combination of conservation measures, such as a conservation tillage system that leaves crop residue on the surface, winter cover crops, contour stripcropping, grassed waterways, terraces, and crop rotations that include grasses and legumes. More intensive management is needed to maintain fertility on this soil than on the less eroded Clearfield soils. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table. Management may be difficult because the soil is poorly drained. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Terraces on the adjacent soils in the uplands may be needed to protect this soil from erosion. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed and interseeding on the contour help to control erosion.

The land capability classification is IIIw.

76C—Ladoga silt loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on narrow ridges and short, convex side slopes, which are at slightly lower elevations than the gently sloping upland ridgetops. Areas generally are long and narrow or irregularly shaped and range from 4 to 15 acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 30 inches thick. The upper part is brown, mottled, friable silty clay loam; the next part is brown, mottled, firm silty clay; and the lower part is mottled yellowish brown, grayish brown, and strong brown, friable and firm silty clay loam. The substratum to a depth of about 60 inches is mottled light brownish gray, strong brown, and yellowish brown silty clay loam. In some places a grayish brown subsoil is as shallow as 24 inches. In other places the surface soil is thinner because of erosion.

Permeability is moderately slow. Runoff is medium. The seasonal high water table is at a depth of 4 to 6 feet. The available water capacity is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tillage is good, but the soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are cultivated or are used for hay or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, water erosion is a hazard. A combination of conservation measures, such as a conservation tillage system that leaves crop residue on the surface, contour farming, contour stripcropping, terraces, and crop rotations that include meadow crops, helps to prevent excessive soil loss. In places, however, contour farming or terracing is difficult because of short, irregular slopes. Deferring tillage during wet periods minimizes compaction and improves tillage. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed and applying cultural measures on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

Many small areas support native hardwoods. This soil is moderately well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

76C2—Ladoga silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on narrow ridges and short, convex side slopes, which are at slightly lower elevations than the nearly level upland ridgetops. Areas generally are long and narrow or irregularly shaped and range from 4 to 15 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 6 inches thick. Plowing has mixed some of the brown subsoil with the surface layer. The subsoil is mottled silty clay loam about 27 inches thick. The upper part is brown and is friable and firm; the next part is grayish brown, yellowish brown, and strong brown and is firm; and the lower part is grayish brown and yellowish brown and is friable. The substratum to a depth of about 60 inches is mottled light brownish gray, strong brown, and yellowish brown silty clay loam. In places a grayish brown subsoil is as shallow as 24 inches.

Included with this soil in mapping are small areas of Armstrong and Lineville soils. Armstrong soils formed in weathered glacial till. They are on stepped, convex, narrow ridgetops and side slopes downslope from the Ladoga soil. They contain more clay than the Ladoga soil. Lineville soils formed in loess underlain by loamy sediment and weathered glacial till. They are on partly stepped, convex, narrow ridgetops downslope from the Ladoga soil. Also included are the severely eroded Ladoga soils. These soils have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Ladoga soils. The included soils make up about 5 to 15 percent of the unit.

Permeability is moderately slow in the Ladoga soil. Runoff is medium. The seasonal high water table is at a depth of 4 to 6 feet. The available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a high supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are cultivated. Some areas are used for hay or pasture. This soil is moderately suited to corn, soybeans, and small grain. If cultivated crops are grown, water erosion is a hazard. A combination of conservation measures, such as a conservation tillage system that leaves crop residue on the surface, contour farming, contour stripcropping, terraces, and crop rotations that include meadow crops, helps to prevent excessive soil loss. In places, however, contour farming or terracing is difficult because of short, irregular slopes. More intensive management is needed to maintain fertility on this soil than on the less eroded Ladoga soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is

needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed and applying cultural measures on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

A few small areas support native hardwoods. This soil is moderately well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

76D—Ladoga silt loam, 9 to 14 percent slopes.

This strongly sloping, moderately well drained soil is on convex or slightly concave side slopes on uplands that commonly border broad, nearly level bottom land. Areas generally are long and narrow or irregularly shaped and range from 4 to 10 acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 3 inches thick. The subsoil is silty clay loam about 28 inches thick. The upper part is brown, mottled, and friable and firm; the next part is mottled grayish brown, yellowish brown, and strong brown and is firm; and the lower part is mottled grayish brown and yellowish brown and is friable. The substratum to a depth of about 60 inches is mottled light brownish gray, strong brown, and yellowish brown silty clay loam. In some places the subsoil is gray. In other places the substratum is loam, which overlies a red, clayey soil. In some areas the surface layer is thinner because of erosion.

Included with this soil in mapping are small areas of Dickinson and Mystic soils. These soils contain more sand than the Ladoga soil. The well drained Dickinson soils are on convex side slopes. The somewhat poorly drained Mystic soils formed in ancient alluvium on concave side slopes that border the valleys of the major streams and their tributaries. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Ladoga soil. Runoff is rapid. The seasonal high water table is at a

depth of 4 to 6 feet. The available water capacity is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil typically has a high supply of available phosphorus and a low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used for hay or pasture. This soil is suited to corn, soybeans, and small grain. Because it is mainly in small areas, it generally is managed along with the adjacent soils, which are more poorly suited to row crops. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, water erosion is a severe hazard. If an intensive row cropping system is used, a combination of conservation tillage, which leaves crop residue on the surface, terraces, contour farming, grassed waterways, contour stripcropping, and crop rotations that include grasses and legumes helps to prevent excessive soil loss. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed and applying cultural measures on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

Many small areas support native hardwoods. This soil is moderately well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

88—Nevin silty clay loam, 0 to 2 percent slopes.

This nearly level, somewhat poorly drained soil is on low stream terraces. Areas are irregular in shape and range from 5 to 15 acres in size.

Typically, the surface layer is black, friable silty clay loam about 7 inches thick. The subsurface layer is very dark gray and very dark grayish brown, friable silty clay

loam about 12 inches thick. The subsoil is friable silty clay loam about 31 inches thick. The upper part is dark grayish brown; the next part is mottled grayish brown and gray; and the lower part is gray and mottled. The substratum to a depth of about 60 inches is light brownish gray silty clay loam. In some places the surface layer is lighter in color and is thinner. In other places the subsoil is grayer.

Permeability is moderate. Runoff is slow. The seasonal high water table is at a depth of about 2 to 4 feet. The available water capacity is high. The content of organic matter is about 4 to 6 percent in the surface layer. The subsoil typically has a medium supply of available phosphorus and a low supply of available potassium. Tilth generally is good, but the soil tends to puddle if worked when wet.

This soil is used mainly for cultivated crops. It is well suited to corn, soybeans, and small grain. Row crops can be grown in most years. Drainage is adequate in this somewhat poorly drained soil. In wet years, however, tile drainage is needed to improve the timeliness of fieldwork and the growing conditions for legumes.

This soil is well suited to pasture and hay. Overgrazing or grazing during wet periods causes surface compaction and puddling. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is I.

93D—Shelby-Adair clay loams, 9 to 14 percent slopes. These strongly sloping soils are on uplands. The well drained Shelby soil is on the lower, convex side slopes, and the moderately well drained Adair soil is on the upper, convex shoulder slopes. Areas are irregularly shaped and range from 5 to 25 acres in size. They are about 55 percent Shelby soil and 35 percent Adair soil. The two soils occur as areas so small that mapping them separately is impractical.

Typically, the Shelby soil has a surface layer of very dark grayish brown, friable clay loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable clay loam about 4 inches thick. The subsoil is clay loam about 31 inches thick. The upper part is dark brown and friable, and the lower part is dark yellowish brown and yellowish brown and is firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of erosion. In some areas, the subsoil

is thinner and the calcareous substratum is closer to the surface.

Typically, the Adair soil has a surface layer of very dark grayish brown, friable clay loam about 8 inches thick. The subsurface layer is dark brown, friable clay loam about 4 inches thick. The subsoil is about 37 inches thick. The upper part is brown, mottled, friable clay loam; the next part is brown, mottled, firm clay; and the lower part is mottled yellowish brown and grayish brown, firm clay loam. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown clay loam. In some places the surface layer is thinner because of erosion. In other places the subsoil is grayer and has a thicker layer of clay.

Included with these soils in mapping are some areas of Clarinda soils. These soils are in coves at the head of drainageways. They are grayer and contain more clay than the Shelby and Adair soils. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Shelby soil and slow in the Adair soil. Runoff is rapid on both soils. The Adair soil has a seasonal high water table at a depth of 1 to 3 feet. The available water capacity is high in both soils. The Adair soil has a high shrink-swell potential. The content of organic matter is about 3 to 4 percent in the surface layer of both soils. The supply of available phosphorus and potassium generally is very low in the subsoil. Tilth is good, but the soils tend to puddle if worked when wet.

Most areas are cultivated. Some of the large areas are used as pasture. These soils are poorly suited to corn and soybeans. They are better suited to small grain. In most areas they are managed along with the adjacent soils. If cultivated crops are grown, erosion is a hazard. Row crops should be grown only to establish hay or pasture. Conservation measures are needed on this soil and on the soils upslope. A system of conservation tillage that leaves crop residue on the surface and contour stripcropping help to prevent excessive soil loss. If terraces are constructed, the cuts should not expose the firm subsoil, which is low in fertility. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soils or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

These soils are suited to grasses for hay. The Adair soil is poorly suited to pasture and to legumes for hay because of the seasonal high water table. The Shelby soil is well suited to pasture and is suited to legumes for hay. Growing grasses and legumes for hay or

pasture is effective in controlling erosion. The Adair soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Overgrazing or grazing when the soils are wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion.

The land capability classification is IVe.

93D2—Shelby-Adair clay loams, 9 to 14 percent slopes, moderately eroded. These strongly sloping soils are on uplands. The well drained Shelby soil is on the lower, convex side slopes, and the moderately well drained Adair soil is on the upper convex shoulder slopes. Areas are irregularly shaped and range from 5 to 25 acres in size. They are about 50 percent Shelby soil and 35 percent Adair soil. The two soils occur as areas so small that mapping them separately is impractical.

Typically, the Shelby soil has a surface layer of very dark grayish brown, friable clay loam about 8 inches thick. Plowing has mixed some of the dark brown and dark yellowish brown subsoil with the surface layer. The subsoil is clay loam about 30 inches thick. The upper part is dark brown and friable; the next part is dark yellowish brown, mottled, and firm; and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of severe erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Typically, the Adair soil has a surface layer of very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some of the brown subsoil with the surface layer. The subsoil is about 34 inches thick. The upper part is brown, mottled, friable clay loam; the next part is brown, mottled, firm clay; and the lower part is mottled yellowish brown and grayish brown, firm clay loam. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown clay loam. In some places the surface layer is thinner because of severe erosion. In other places the subsoil is grayer and has a thicker layer of clay.

Included with these soils in mapping are small areas of Clarinda soils. These soils are in coves at the head

of drainageways. They are grayer and contain more clay than the Shelby and Adair soils. Also included are the severely eroded Shelby and Adair soils. Adair soils are on shoulder slopes, and Shelby soils are on the lower side slopes. Both soils generally are in scattered areas $\frac{1}{2}$ to 1 acre in size. They have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Shelby and Adair soils. The included soils make up about 5 to 15 percent of the unit.

Permeability is moderately slow in the Shelby soil and slow in the Adair soil. Runoff is rapid on both soils. The Adair soil has a seasonal high water table at a depth of 1 to 3 feet. The available water capacity is high in both soils. The Adair soil has a high shrink-swell potential. The content of organic matter is about 2.2 to 3.2 percent in the surface layer of both soils. The supply of available phosphorus and potassium generally is very low in the subsoil. Tilth is fair. The soils tend to puddle if worked when wet.

Most areas are cultivated. Some of the large areas are used as pasture. These soils are poorly suited to corn and small grain. In most areas they are managed along with the adjacent soils. Conservation measures are needed on these soils and on the soils upslope. If cultivated crops are grown, water erosion is a hazard. Row crops should be grown only to establish hay or pasture. A system of conservation tillage that leaves crop residue on the surface and contour stripcropping help to prevent excessive soil loss. If terraces are constructed, the cuts should not expose the firm subsoil, which is low in fertility. More intensive management is needed to maintain fertility on these soils than on the less eroded Adair and Shelby soils. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soils or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

These soils are suited to grasses for hay. The Adair soil is poorly suited to pasture and to legumes for hay because of the seasonal high water table. The Shelby soil is well suited to pasture and is suited to legumes for hay. Growing grasses and legumes for hay or pasture is effective in controlling erosion. The Adair soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soils are wet causes surface compaction,

which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion.

The land capability classification is IVe.

94D—Mystic-Caleb loams, 9 to 14 percent slopes.

These strongly sloping soils are on the escarpments of high stream benches and on some concave foot slopes in the uplands. The somewhat poorly drained Mystic soil is on the upper, convex or concave side slopes, and the moderately well drained Caleb soil is on the lower, convex side slopes. Areas are irregular in shape and range from 5 to 10 acres in size. They are about 60 percent Mystic soil and 40 percent Caleb soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Mystic soil has a surface layer of very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 3 inches thick. The subsoil is about 46 inches thick. The upper part is brown, mottled, firm clay; the next part is mottled strong brown, dark yellowish brown, grayish brown, and brown, firm clay loam; and the lower part is mottled strong brown, yellowish red, light brownish gray, and light gray, friable clay loam. The substratum to a depth of about 60 inches is strong brown, mottled clay loam. In some areas the soil contains more silt and less sand. In other areas the surface layer is thinner because of erosion.

Typically, the Caleb soil has a surface layer of very dark gray, friable loam about 8 inches thick. The subsurface layer is brown, friable loam about 4 inches thick. The subsoil is about 44 inches thick. The upper part is dark yellowish brown, firm clay loam; the next part is yellowish brown, friable sandy clay loam; and the lower part is yellowish brown, mottled, friable sandy loam. The substratum to a depth of about 60 inches is mottled brown, strong brown, and grayish brown sandy clay loam. In places the surface layer is thinner because of erosion.

Permeability is slow in the Mystic soil and moderate in the Caleb soil. Runoff is rapid on both soils. The Mystic soil has a seasonal high water table at a depth of 1 to 3 feet, and the Caleb soil has one at a depth of 3 to 5 feet. The available water capacity is high in both soils. The Mystic soil has a high shrink-swell potential. The content of organic matter is about 2.5 to 3.5 percent in the surface layer of both soils. The supply of

available phosphorus generally is very low in the subsoil, and the supply of available potassium is low. Tilth is fair. The soils tend to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used for pasture or hay. These soils are poorly suited to corn and soybeans. They are better suited to small grain. If cultivated crops are grown, erosion is a hazard. Row crops should be grown only to establish hay or pasture. A combination of conservation measures, such as contour farming, grassed waterways, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops, helps to prevent excessive soil loss. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soils or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

These soils are suited to grasses for hay. They are suited to legumes for hay if an adequate drainage system is installed. The Mystic soil is poorly suited to pasture, but the Caleb soil is well suited. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the Mystic soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity in areas of the Mystic soil. Properly located drainage tile in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture on the Mystic soil. Overgrazing or grazing when the soils are wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

A few small areas support native hardwoods. These soils are suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

94D2—Mystic-Caleb complex, 9 to 14 percent slopes, moderately eroded. These strongly sloping soils are on the escarpments of high stream benches and on some concave foot slopes in the uplands. The

somewhat poorly drained Mystic soil is on the upper, convex or concave side slopes, and the moderately well drained Caleb soil is on the lower, convex side slopes. Areas are irregular in shape and range from 5 to 10 acres in size. They are about 55 percent Mystic soil and 35 percent Caleb soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Mystic soil has a surface layer of dark brown, friable clay loam about 6 inches thick. Plowing has mixed some of the brown and strong brown subsoil with the surface layer. The subsoil is about 46 inches thick. The upper part is brown, mottled, firm clay; the next part is mottled strong brown, dark yellowish brown, grayish brown, and brown, firm clay loam; and the lower part is mottled strong brown, yellowish red, light brownish gray, and light gray, friable clay loam. The substratum to a depth of about 60 inches is strong brown, mottled clay loam. In some areas the soil contains more silt and less sand. In other areas the surface layer is thinner because of severe erosion.

Typically, the Caleb soil has a surface layer of dark brown, friable loam about 6 inches thick. Plowing has mixed some of the yellowish brown subsoil with the surface layer. The subsoil is about 43 inches thick. The upper part is dark yellowish brown, firm clay loam; the next part is yellowish brown, friable sandy clay loam; and the lower part is yellowish brown, mottled, friable sandy loam. The substratum to a depth of about 60 inches is mottled brown, strong brown, and grayish brown sandy clay loam. In places the surface layer is thinner because of erosion.

Included with these soils in mapping are small areas of the severely eroded Mystic and Caleb soils. Mystic soils are on the upper side slopes, and Caleb soils are on the lower side slopes. Both are in scattered areas $\frac{1}{2}$ to 1 acre in size. They have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Mystic and Caleb soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Mystic soil and moderate in the Caleb soil. Runoff is rapid on both soils. The Mystic soil has a seasonal high water table at a depth of 1 to 3 feet, and the Caleb soil has one at a depth of 3 to 5 feet. The available water capacity is high in both soils. The Mystic soil has a high shrink-swell potential. The content of organic matter is about 2 to 3 percent in the surface layer of both soils. The supply of available phosphorus generally is very low in the subsoil, and the supply of available potassium is low. Tilth is fair. The soils tend to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture or hayland. These soils are poorly suited to corn and soybeans. They are better suited to small grain. If cultivated crops are grown, water erosion is a hazard. Row crops should be grown only to establish hay or pasture. A combination of contour farming, grassed waterways, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops helps to prevent excessive soil loss. More intensive management is needed to maintain fertility on these soils than on the less eroded Mystic and Caleb soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soils or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

These soils are suited to grasses for hay. They are suited to legumes if an adequate drainage system is installed. The Mystic soil is poorly suited to pasture, but the Caleb soil is well suited. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the Mystic soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity in areas of the Mystic soil. Properly located drainage tile in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture on the Mystic soil. Overgrazing or grazing when the soils are wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

These soils are suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

131B—Pershing silt loam, 2 to 5 percent slopes.

This gently sloping, moderately well drained or somewhat poorly drained soil is on ridges in the uplands. Areas are irregularly shaped or long and narrow and range from 3 to 10 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil extends to a depth of

about 60 inches. It is mottled. The upper part is brown, friable silty clay loam; the next part is grayish brown, firm silty clay; and the lower part is light brownish gray, firm and friable silty clay loam. In places the subsurface layer is very dark gray.

Permeability is slow. Runoff is medium. The available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated or are used for hay or pasture. This soil is moderately well suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, contour stripcropping, crop rotations that include meadow crops, and terraces help to prevent excessive soil loss. Terrace cuts should not expose the clayey subsoil. If the subsoil is exposed, working the soil is difficult and the terrace channels may become seepy. A combination of tile drainage and terraces can help to control erosion and improve the timeliness of fieldwork in years when rainfall is above normal. Grassed waterways help to prevent gully erosion. This slowly permeable soil tends to warm up more slowly in the spring than the more permeable soils, and it dries out more slowly after periods of rainfall. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses for hay and is suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity

of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

Many areas are used as woodland. This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IIIe.

131C—Pershing silt loam, 5 to 9 percent slopes.

This moderately sloping, moderately well drained or somewhat poorly drained soil is on narrow ridges and short, convex side slopes at the slightly lower elevations in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 130 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is brown, friable silty clay loam; the next part is dark grayish brown and grayish brown, firm silty clay; and the lower part is grayish brown and light brownish gray, firm and friable silty clay loam. In some places the surface layer is thinner because of erosion. In other places the subsurface layer is very dark gray.

Included with this soil in mapping are small areas of Armstrong and Bucknell soils. These soils are on the lower parts of the side slopes. They have more clay in the subsoil than the Pershing soil. They make up about 5 to 10 percent of the unit.

Permeability is slow in the Pershing soil. Runoff is medium. The available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, contour stripcropping, and crop

rotations that include grasses and legumes. Terrace cuts should not expose the clayey subsoil. If the subsoil is exposed, working the soil is difficult and the terrace channels may become seepy. A combination of tile drainage and terraces can help to control erosion and improve the timeliness of fieldwork in years when rainfall is above normal. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

Many areas are used as woodland. This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IIIe.

131C2—Pershing silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained or somewhat poorly drained soil is on narrow ridges and short side slopes at the slightly lower elevations in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 130 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 5 inches thick.

Plowing has mixed some of the brown subsoil with the surface layer. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is brown, friable silty clay loam; the next part is grayish brown, firm silty clay; and the lower part is light brownish gray, firm and friable silty clay loam.

Included with this soil in mapping are small areas of Armstrong and Bucknell soils. These soils have a subsoil that formed mainly in a paleosol that weathered from glacial till. They are on the lower parts of the side slopes. Also included are the severely eroded Pershing soils, which generally are in areas on shoulder slopes $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. These soils have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Pershing soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Pershing soil. Runoff is medium. The available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are cultivated or are used for hay or pasture. This soil is suited to corn, soybeans, and small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, water erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, contour stripcropping, terraces, and crop rotations that include grasses and legumes help to prevent excessive soil loss. Terrace cuts should not expose the clayey subsoil. If the subsoil is exposed, working the soil is difficult and the terrace channels may become seepy. A combination of tile drainage and terraces can help to control erosion and improve the timeliness of fieldwork in years when rainfall is above normal. Grassed waterways help to prevent gully erosion. More intensive management is needed to maintain fertility on this soil than on the less eroded Pershing soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion.

Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IIIe.

131D—Pershing silt loam, 9 to 14 percent slopes.

This strongly sloping, moderately well drained or somewhat poorly drained soil is on convex side slopes in the uplands that are commonly adjacent to wide and moderately wide bottom land along the major streams and rivers. Areas typically are long and narrow and range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is brown, friable silty clay loam; the next part is grayish brown, firm silty clay; and the lower part is light brownish gray, firm and friable silty clay loam. In some places the surface layer is thinner because of erosion. In other places the subsurface layer is very dark gray.

Included with this soil in mapping are small areas of Dickinson and Mystic soils. These soils contain more sand than the Pershing soil. Dickinson soils are in scattered areas, and Mystic soils are on the lower parts of the side slopes. The included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Pershing soil. Runoff is rapid. The seasonal high water table is at a depth of 2 to 4 feet. The available water capacity is high. The



Figure 7.—An area of Pershing silt loam, 9 to 14 percent slopes, used for hay.

shrink-swell potential also is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used for hay or pasture. Some areas are cultivated. This soil is poorly suited to corn, soybeans, and small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, contour stripcropping, and crop rotations that include grasses and legumes help to prevent excessive soil loss. Terrace cuts should not

expose the clayey subsoil. If the subsoil is exposed, working the soil is difficult and the terrace channels may become seepy. A combination of tile drainage and terraces can help to control erosion and improve the timeliness of fieldwork in years when rainfall is above normal. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay and pasture (fig. 7). It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly

located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

Many areas are used as woodland. This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IVe.

131D2—Pershing silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or somewhat poorly drained soil is on convex side slopes in the uplands that are commonly adjacent to wide and moderately wide bottom land along the major streams and rivers. Areas typically are long and narrow and range from 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 5 inches thick. Plowing has mixed some of the brown subsoil with the surface layer. The subsoil is about 44 inches thick. It is mottled. The upper part is brown, friable silty clay loam; the next part is grayish brown, firm silty clay; and the lower part is light brownish gray, firm and friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam.

Included with this soil in mapping are small areas of Dickinson and Mystic soils. These soils contain more sand than the Pershing soil. Dickinson soils are in scattered areas throughout the map unit. Mystic soils are on the lower parts of the side slopes. Also included are severely eroded Pershing soils, which generally are in scattered areas $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. These soils have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Pershing soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Pershing soil. Runoff is rapid. The available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is 2 to 3 percent in the surface layer. The soil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting retards seedling emergence and development.

Most areas are cultivated or are used for hay or pasture. This soil is poorly suited to corn, soybeans, and small grain. Because it is mainly in small areas, it generally is farmed along with adjacent soils that are better suited to row crops. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, water erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, contour stripcropping, terraces, and crop rotations that include grasses and legumes help to prevent excessive soil loss. Terrace cuts should not expose the clayey subsoil. If the subsoil is exposed, working the soil is difficult and the terrace channels may become seepy. A combination of tile drainage and terraces can help to control erosion and improve the timeliness of fieldwork in years when rainfall is above normal. Grassed waterways help to prevent gully erosion. More intensive management is needed to maintain fertility on this soil than on the less eroded Pershing soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay and pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the

pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IVe.

132C—Weller silt loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on narrow ridges and on short, convex side slopes in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 30 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsurface layer is brown and pale brown, friable silt loam about 4 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is yellowish brown, friable silty clay loam; the next part is yellowish brown, mottled, firm silty clay; and the lower part is light brownish gray, mottled, firm and friable silty clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of erosion.

Included with this soil in mapping are small areas of Keswick soils. These soils are on the lower side slopes. They have a subsoil that contains more clay than that of the Weller soil. They make up about 5 to 10 percent of the unit.

Permeability is slow in the Weller soil. Runoff is medium. The available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is 2 to 3 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet. It crusts after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture or woodland. Some areas are cultivated. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, crop rotations that include grasses and legumes, contour stripcropping, and terraces help to prevent excessive soil loss. In places contour farming or terracing is difficult because of irregular, short slopes. Terrace cuts should not expose the clayey subsoil. If

the subsoil is exposed, working the soil is difficult and the terrace channels may become seepy. A combination of tile drainage and terraces can help to control erosion and improve the timeliness of fieldwork in years when rainfall is above normal. Grassed waterways help to prevent gully erosion. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 or 4 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IIIe.

172—Wabash silty clay, 0 to 2 percent slopes. This nearly level, very poorly drained soil is in low areas on bottom land along the major streams and along the smaller tributaries. It is occasionally flooded. Areas are irregularly shaped and range from 10 to 200 acres in size.

Typically, the surface layer is black, firm silty clay about 8 inches thick. The subsurface layer also is black, firm silty clay. It is about 12 inches thick. The subsoil to a depth of about 60 inches is black, mottled, very firm

silty clay. In some places the surface layer and subsoil contain less clay. In other places the surface layer is silt loam and has a low content of organic matter.

Included with this soil in mapping are small areas that are ponded for long periods. These are areas of shallow surface drains. They have few or no adequate outlets. They make up about 5 percent of the unit.

Permeability is very slow in the Wabash soil. Runoff also is very slow. The seasonal high water table is at a depth of 1 foot. The available water capacity is moderate. The shrink-swell potential is very high. The content of organic matter is about 4 to 6 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is very poor. The soil tends to puddle if worked when wet.

Most areas are cultivated. If drained and protected from flooding, this soil is suited to corn, soybeans, and small grain. In undrained areas it is better suited to pasture. Tile drainage generally is not recommended because permeability is very slow and drainage outlets are not readily available. A good surface drainage system should be installed to remove the excess surface water. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. Because of the clayey surface layer, this soil is difficult to till. Fall plowing improves the timeliness of fieldwork but increases the susceptibility to soil blowing. Leaving the plowed surface rough and alternating plowed and unplowed strips help to control soil blowing. Chisel plowing, which leaves crop residue on the surface, also helps to control soil blowing. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table and the flooding. Management may be difficult because the soil is poorly drained and occasionally flooded. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root

development and increases the extent of ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

A few areas support native hardwoods. This soil is moderately well suited to trees. Because of the very poor drainage, the use of equipment should be restricted to dry periods or to the winter months when the ground is frozen. Machinery equipped with special high flotation tires or tracks can be used for harvesting or management if it is necessary during wet periods. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Erosion is not a limiting factor during logging activities and related road construction.

The land capability classification is IIIw.

172+—Wabash silt loam, overwash, 0 to 2 percent slopes. This nearly level, very poorly drained soil is in low areas on second bottoms along the major streams and along the smaller tributaries. It is occasionally flooded. Areas are irregularly shaped and range from 10 to 50 acres in size.

Typically, the surface layer is stratified very dark gray and dark grayish brown, friable silt loam about 11 inches thick. Below this is a buried surface layer of black, firm silty clay about 20 inches thick. The subsoil to a depth of about 60 inches is black, mottled, very firm silty clay. In some areas it contains less clay.

Included with this soil in mapping are small areas that are ponded for long periods. These are areas of shallow drainage ditches and shallow natural drains. They have few or no adequate outlets. They make up about 5 to 10 percent of the unit.

Permeability is very slow in the Wabash soil. Runoff also is very slow. The seasonal high water table is at a depth of 1 foot. The available water capacity is moderate. The shrink-swell potential is very high. The content of organic matter is about 2 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. If drained and protected from flooding, this soil is suited to corn, soybeans, and small grain. In undrained areas it is better suited to pasture. Tile drainage generally is not recommended because permeability is slow and drainage outlets are not readily available. A good surface drainage system

should be installed to remove the excess surface water. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table and the flooding. Management may be difficult because the soil is poorly drained and is occasionally flooded. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the extent of ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

A few areas support native hardwoods. This soil is moderately well suited to trees. Because of the very poor drainage, the use of equipment should be restricted to dry periods or to winter months when the ground is frozen. Machinery equipped with special high flotation tires or tracks can be used for harvesting or management if it is necessary during wet periods. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Erosion is not a limiting factor during logging activities and related road construction.

The land capability classification is IIIw.

175C—Dickinson fine sandy loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on ridges and side slopes in the uplands. Areas are irregular in shape and range from 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 9 inches thick. The subsurface layer is very dark grayish brown,

friable fine sandy loam about 7 inches thick. The subsoil is yellowish brown, very friable fine sandy loam about 25 inches thick. The substratum to a depth of about 60 inches is yellowish brown loamy fine sand.

Permeability is moderately rapid in the upper part of the profile and rapid in the substratum. Runoff is medium. The available water capacity is low. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content; however, it tends to crust after hard rains.

Most areas are cultivated or are used for hay. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, soil blowing and water erosion are hazards. The soil is droughty, and all crop production is dependent on an adequate amount of rainfall and its timeliness. A conservation tillage system that leaves crop residue on the surface throughout the year helps to control erosion and soil blowing and conserves moisture. Stripcropping also helps to control erosion and soil blowing. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 or 4 years.

Growing grass and legumes for pasture or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

The land capability classification is IIIe.

175D—Dickinson fine sandy loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on ridges and side slopes in the uplands. Areas are irregular in shape and range from 5 to 25 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable fine sandy loam about 7 inches thick. The subsoil is yellowish brown, very friable fine sandy loam about 22 inches thick. The substratum to a depth of about 60 inches is yellowish brown loamy fine sand. In a few areas silty clay loam is at a depth of about 4 feet.

Permeability is moderately rapid in the upper part of the profile and rapid in the substratum. Runoff is medium. The available water capacity is low. The

content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content; however, it tends to crust after hard rains.

Most areas are cultivated or are used for hay. This soil is poorly suited to corn, soybeans, and small grain. If cultivated crops are grown, soil blowing and water erosion are hazards. The soil is droughty, and all crop production is dependent on an adequate amount of rainfall and its timeliness. A conservation tillage system that leaves crop residue on the surface throughout the year helps to control erosion and soil blowing and conserves moisture. Stripcropping also helps to control erosion and soil blowing. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 or 4 years.

Growing grasses and legumes for pasture or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and deferment of grazing during dry periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

The land capability classification is IVe.

179D—Gara loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on irregular, narrow ridges and convex side slopes in the uplands. The landscape is dissected by small drainageways. Slopes typically are short. Areas range from 5 to 30 acres in size. Most are irregular in shape, but some are long and narrow.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 5 inches thick. The subsoil is clay loam about 33 inches thick. The upper part is dark grayish brown and friable and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is mottled yellowish brown and strong brown, calcareous clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with this soil in mapping are areas of the somewhat poorly drained Bucknell soils and areas of poorly drained soils. These soils are in coves near the

head of drainageways and on the upper parts of the landscape. They have a subsoil of gray clay. Also included are the moderately well drained Armstrong soils, which formed in a red, clayey paleosol that weathered from glacial till. These soils are on shoulder slopes on the upper parts of the landscape. They have a clayey subsoil. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Gara soil. Runoff is rapid. The available water capacity is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used for pasture or hay. This soil is poorly suited to corn and small grain. If cultivated crops are grown, erosion is a hazard. Row crops should be grown only to establish hay or pasture. Conservation measures are needed on this soil and on the soils upslope. A system of conservation tillage that leaves crop residue on the surface and contour stripcropping help to prevent excessive soil loss. If terraces are constructed, the cuts should not expose the underlying firm glacial till, which is low in fertility. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses and legumes for hay and is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

Some areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

179D2—Gara loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on irregular, narrow ridges and convex side slopes in the uplands. The landscape is dissected by small drainageways. Slopes typically are short. Areas range from 5 to 30 acres in size. Most are irregular in shape, but some are long and narrow.

Typically, the surface layer is very dark grayish brown, friable loam about 6 inches thick. Plowing has mixed some of the dark grayish brown subsoil with the surface layer. The subsoil is clay loam about 30 inches thick. The upper part is dark grayish brown and friable and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is mottled yellowish brown and strong brown, calcareous clay loam. In some places the surface layer is thicker and darker. In other places, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with this soil in mapping are areas of the somewhat poorly drained Bucknell soils, areas of poorly drained soils, and areas of the moderately well drained Armstrong soils. The Bucknell and poorly drained soils are in coves near the head of drainageways and on the upper parts of the landscape. They have a subsoil of gray clay. Armstrong soils formed in a red, clayey paleosol and have a clayey subsoil. They are on the higher shoulder slopes. Also included are the severely eroded Gara soils. These soils are in areas about ½ acre in size. They have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Gara soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Gara soil. Runoff is rapid. The available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Many areas are cultivated. Some areas are used for pasture or hay. Nearly all areas have been cultivated at some time. This soil is poorly suited to corn and small grain. If cultivated crops are grown, water erosion is a severe hazard. Row crops should be grown only to establish hay or pasture. Conservation measures are needed on this soil and on the soils upslope. A system of conservation tillage that leaves crop residue on the surface and contour stripcropping help to prevent excessive soil loss. If terraces are constructed, the cuts

should not expose the underlying firm glacial till, which is low in fertility. If the glacial till is exposed, topsoil is needed. More intensive management is needed to maintain fertility on this soil than on the less eroded Gara soils. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses and legumes for hay and is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

A few scattered small areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

179D3—Gara clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on narrow ridges and convex side slopes in the uplands. The landscape is dissected by small drainageways. Slopes typically are short. Areas range from 5 to 15 acres in size. Most are irregular in shape, but some are long and narrow.

Typically, the surface layer is yellowish brown and dark grayish brown, friable clay loam about 6 inches thick. It has about 15 to 20 percent pockets of dark grayish brown, friable clay loam from the original surface layer. The subsoil is clay loam about 29 inches thick. The upper part is dark grayish brown and yellowish brown, mottled, and friable and firm. The lower part is yellowish brown and firm. The substratum to a depth of about 60 inches is mottled yellowish brown and strong brown, calcareous clay loam. In some places the surface layer is thicker and darker. In other places, the subsoil is thinner and the calcareous

substratum is closer to the surface.

Included with this soil in mapping are areas of the somewhat poorly drained Bucknell soils and areas of poorly drained soils. These soils are in coves near the head of drainageways and on the upper parts of the landscape. They have a subsoil of gray clay. Also included are the moderately well drained Armstrong soils. These soils formed in a red, clayey paleosol and have a clayey subsoil. They are on the higher shoulder slopes. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Gara soil. Runoff is rapid. The available water capacity is high. The content of organic matter is 1 to 2 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is poor. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Many areas are cultivated. Some are used for pasture or hay. Nearly all areas have been cultivated at some time. This soil generally is unsuited to corn and soybeans. It is better suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, water erosion is a severe hazard. Row crops should be grown only to establish hay or pasture. A system of conservation tillage that leaves crop residue on the surface and contour stripcropping help to prevent excessive soil loss. If terraces are constructed, the cuts should not expose the underlying firm glacial till, which is low in fertility. If the glacial till is exposed, topsoil is needed. More intensive management is needed to maintain fertility on this soil than on the less eroded Gara soils. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is poorly suited to grasses and legumes for hay but is suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or

hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

This soil is poorly suited to trees. Seedlings do not survive or grow well on this severely eroded soil. Site preparation and control of competing plants are necessary to establish seedlings. Disturbing the surface during planting causes water erosion.

The land capability classification is Vle.

179E—Gara loam, 14 to 18 percent slopes. This moderately steep, well drained soil is on narrow ridges and convex side slopes in the uplands. The landscape is dissected by small drainageways. Areas generally are long and narrow and are parallel to intermittent streams. They range from 5 to 30 acres in size.

Typically, the surface layer is very dark gray, friable loam about 7 inches thick. The subsurface layer is dark grayish brown, friable loam about 5 inches thick. The subsoil is yellowish brown, mottled, firm clay loam about 31 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with this soil in mapping are areas of the moderately well drained Armstrong soils. These soils are on narrow ridges and shoulder slopes on the upper parts of the landscape. They have a subsoil of red clay. Also included are the somewhat poorly drained Mystic soils. These soils formed in ancient alluvium. They are on foot slopes on the lower parts of the landscape. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Gara soil. Runoff is rapid. The available water capacity is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture or woodland. This soil generally is unsuited to row crops and small grain. It is poorly suited to grasses and legumes for hay but is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture

in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

A few areas support native hardwoods. This soil is suited to trees. Carefully locating logging trails or roads and laying out the trails and roads on the contour or nearly on the contour can reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. Special equipment can be used. Caution is needed in operating the equipment. Seedlings survive and grow well.

The land capability classification is Vle.

179E2—Gara loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on narrow ridges and convex side slopes in the uplands. The landscape is dissected by small drainageways. Areas generally are long and narrow and are parallel to intermittent streams. They range from 5 to 30 acres in size.

Typically, the surface layer is very dark gray, friable loam about 6 inches thick. Plowing has mixed some of the yellowish brown subsoil with the surface layer. The subsoil is clay loam about 30 inches thick. The upper part is dark grayish brown and yellowish brown and is friable, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of severe erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with this soil in mapping are areas of the moderately well drained Armstrong and somewhat poorly drained Bucknell and Mystic soils. Armstrong soils are on narrow ridges and shoulder slopes on the upper parts of the landscape. They have a subsoil of red clay. Bucknell soils are on shoulder slopes and side slopes. They have a subsoil of gray clay. Mystic soils formed in ancient alluvium. They are on foot slopes on the lower parts of the landscape. Also included are the severely eroded Gara soils in areas about ½ acre in size. These soils have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Gara soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Gara soil. Runoff is rapid. The available water capacity is high.

The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used for hay or pasture. Some are cultivated. Most areas have been cultivated at some time. This soil generally is unsuited to row crops and small grain. It is poorly suited to grasses and legumes for hay but is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

This soil is suited to trees. Carefully locating logging trails or roads and laying out the trails and roads on the contour or nearly on the contour can reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. Special equipment can be used. Caution is needed in operating equipment. Seedlings survive and grow well.

The land capability classification is Vle.

179F—Gara loam, 18 to 25 percent slopes. This steep, well drained soil is on convex side slopes in the uplands along the major streams and in valleys. The landscape is dissected by small drainageways. Areas generally are long and narrow and are parallel to intermittent streams. They range from 5 to 30 acres in size.

Typically, the surface layer is very dark gray, friable loam about 6 inches thick. The subsurface layer is dark grayish brown, friable loam about 5 inches thick. The subsoil is yellowish brown, mottled, firm clay loam about 30 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Permeability is moderately slow. Runoff is very rapid. The available water capacity is high. The content of organic matter is about 2.5 to 3.5 percent in the surface

layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. It is better suited to permanent pasture, trees, and wildlife habitat. A permanent cover of plants is effective in controlling sheet and gully erosion.

Growing grasses and legumes for pasture or hay is effective in controlling erosion. This soil is poorly suited to hay but is suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, using special equipment and applying cultural measures on the contour help to control erosion. Brush control is needed in most pastured areas because of overgrazing and low or moderate forage production.

Many areas support native hardwoods. This soil is suited to trees. Carefully locating logging trails or roads and laying out the trails and roads on the contour or nearly on the contour can reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. Special equipment can be used. Caution is needed in operating the equipment. Seedlings survive and grow well.

The land capability classification is Vle.

179F2—Gara loam, 18 to 25 percent slopes, moderately eroded. This steep, well drained soil is on convex side slopes in the uplands along the major streams and in valleys. The landscape is dissected by small drainageways and gullies. Areas generally are long and narrow and are parallel to intermittent streams. They range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 5 inches thick. Plowing has mixed some of the yellowish brown subsoil with the surface layer. The subsoil is clay loam about 29 inches thick. The upper part is dark grayish brown and yellowish brown and is friable, and the lower part is yellowish brown, mottled, and firm. The substratum to a

depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. In some places the surface layer is thicker and darker. In other places it is thinner because of severe erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with this soil in mapping are the severely eroded Gara soils. These soils are in scattered areas about ½ acre in size. They have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Gara soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Gara soil. The available water capacity is high. Runoff is very rapid. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil typically has a low supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture or woodland. This soil generally is unsuitable for cultivated crops because of the slope and a severe hazard of erosion. A permanent cover of plants is effective in controlling sheet and gully erosion.

Growing grasses or legumes for pasture or hay is effective in controlling erosion. This soil is poorly suited to hay and is moderately well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, using special equipment and applying cultural measures on the contour help to control erosion. Brush control is needed in most pastured areas because of overgrazing and low or moderate forage production.

A few scattered areas support native hardwoods. This soil is suited to trees. Carefully locating logging trails or roads and laying out the trails and roads on the contour or nearly on the contour can reduce the hazard of erosion. Because of the slope, operating equipment is hazardous. Special equipment can be used. Caution is needed in operating the equipment. Seedlings survive and grow well.

The land capability classification is Vlle.

192C—Adair clay loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on the slightly lower, narrow ridges, on short, convex side slopes, and on shoulder slopes in the uplands. Areas are irregularly shaped and range from 3 to 15 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 8 inches thick. The subsurface layer is dark brown, friable clay loam about 5 inches thick. The subsoil is about 38 inches thick. The upper part is dark brown, mottled, friable clay loam; the next part is brown, mottled, firm clay; and the lower part is mottled yellowish brown, strong brown, and grayish brown, firm clay loam. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown clay loam. In some places the surface layer is thinner because of erosion. In other places the subsoil is grayer and has a thicker layer of clay.

Permeability is slow. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. Some areas are used as pasture. In most areas this soil is managed along with the adjacent soils. It is suited to corn, soybeans, and small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in row cropped areas by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Overgrazing or grazing when the soil is wet

causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion.

The land capability classification is IIIe.

192C2—Adair clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on the slightly lower, narrow ridges, on short, convex side slopes, and on shoulder slopes in the uplands. Areas are long and narrow or irregularly shaped and range from 3 to 15 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some of the brown subsoil with the surface layer. The subsoil is about 35 inches thick. The upper part is dark brown, mottled, friable clay loam; the next part is mottled yellowish brown, brown, and strong brown, firm clay; and the lower part is mottled yellowish brown and grayish brown, firm clay loam. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown clay loam. In some areas the subsoil is grayer and has a thicker layer of clay.

Included with this soil in mapping are the poorly drained Clarinda soils. These soils are on the upper parts of the side slopes in coves. Also included are the severely eroded Adair soils. These soils are in scattered areas about $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. They have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Adair soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Adair soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. Some of the large areas are used as pasture. In most areas this soil is managed along with the adjacent soils. It is suited to corn, soybeans, and small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, water erosion is a severe

hazard. It can be controlled in row cropped areas by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. More intensive management is needed to maintain fertility on this soil than on the less eroded Adair soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion.

The land capability classification is IIIe.

192D2—Adair clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on short, convex side slopes and narrow ridges in the uplands. It is at slightly lower elevations than the moderately sloping soils on loess-covered ridges and at higher elevations than the soils on side slopes that formed in glacial till. Areas are irregularly shaped or long and narrow and range from 4 to 15 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some of the brown subsoil with the surface layer. The subsoil is about 34 inches thick. The upper part is dark brown, mottled, friable clay loam; the next part is mottled yellowish brown, brown, and strong brown, firm clay; and the lower part is mottled yellowish brown and grayish brown, firm clay loam. The substratum to a depth of about 60 inches is mottled

grayish brown and yellowish brown clay loam. In some areas the subsoil is grayer and has a thicker layer of clay.

Included with this soil in mapping are the poorly drained Clarinda soils. These soils are on the upper parts of the side slopes in coves. Also included are the severely eroded Adair soils. These soils are in scattered areas about $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. They have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Adair soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Adair soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. Some larger areas are used as pasture. In most areas this soil is managed along with the adjacent soils. It is poorly suited to corn, soybeans, and small grain. If row crops are grown, water erosion is a severe hazard. Conservation measures are needed on this soil and on the soils upslope. Erosion can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. More intensive management is needed to maintain fertility on this soil than on the less eroded Adair soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates,

pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion.

The land capability classification is IVe.

211—Edina silt loam, 0 to 1 percent slopes. This nearly level, poorly drained soil is on broad upland flats. It is subject to ponding. Areas are irregular in shape and range from 3 to 10 acres in size.

Typically, the surface layer is black and dark gray, friable silt loam about 9 inches thick. The subsurface layer is dark gray and gray, mottled, friable silt loam about 6 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is very dark gray and dark gray, mottled, firm silty clay; the next part is gray and grayish brown, mottled, firm silty clay; and the lower part is grayish brown, mottled, friable silty clay loam. In places the surface soil is black, friable silty clay loam.

Permeability is very slow. Runoff also is very slow. The available water capacity is high. The seasonal high water table is at a depth of 0.5 foot to 2.0 feet. The shrink-swell potential is very high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil typically has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain. Adequate subsurface drainage is very difficult to establish because of the very slow permeability of the soil. A surface drainage system is needed to minimize ponding early in spring and to prevent the drowning of crops. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. The ridge system should be designed so that water can drain off the soil. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table and the ponding. Management may be difficult because the soil is poorly drained and is ponded for brief periods. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. A surface drainage system

may be needed to protect the soil from ponding. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the extent of ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIIw.

212—Kennebec silt loam, 0 to 2 percent slopes.

This nearly level, moderately well drained soil is on bottom land along the major streams and along some of the smaller tributaries. It is occasionally flooded. Areas are elongated and may extend for 1 mile or more. They range from 10 to 70 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is friable silt loam about 40 inches thick. The upper part is black and very dark grayish brown; the next part is black, very dark brown, and very dark grayish brown; and the lower part is very dark gray and mottled. The substratum to a depth of about 60 inches is dark gray, mottled silt loam. In some places the content of organic matter in the surface layer is lower. In other places the subsurface layer is grayer and thinner.

Included with this soil in mapping are small areas of Nodaway, Humeston, and Zook soils. Nodaway soils are near stream channels. They are stratified and have a surface layer that is lighter in color than that of the Kennebec soil. The poorly drained Humeston and Zook soils are in the lower areas on the flood plains. They contain more clay than the Kennebec soil. The included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Kennebec soil. Runoff is slow. The seasonal high water table is at a depth of 3 to 5 feet. The available water capacity is very high. The content of organic matter is about 4 to 6 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a medium supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. If protected from flooding, this soil is well suited to corn, soybeans, and small grain. It is farmed along with the adjacent soils, which are more poorly suited to row crops. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic

material improves fertility and increases the rate of water infiltration.

Most of the narrow areas are used as permanent pasture. This soil is well suited to grasses for pasture and hay. It is suited to legumes if an adequate drainage system is installed and flooding is controlled.

Overgrazing or grazing during wet periods causes surface compaction and puddling. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is I.

220—Nodaway silt loam, 0 to 2 percent slopes.

This nearly level, moderately well drained soil is on bottom land along the major streams and along the small tributaries. It is occasionally flooded. The current stream channels with shallow to deep old stream meanders generally are in areas of this soil. Areas are elongated and extend for many miles. They are several hundred acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 7 inches thick. The substratum to a depth of about 60 inches is stratified very dark gray, dark grayish brown, and grayish brown silt loam. In some areas the surface layer is loam or sandy loam.

Included with this soil in mapping are scattered small areas of sandy soils. These soils occur as sandbars at the higher elevations along stream channels. They make up about 5 to 10 percent of the unit.

Permeability is moderate in the Nodaway soil. Runoff is slow. The seasonal high water table is at a depth of 3 to 5 feet. The available water capacity is very high. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated (fig. 8). If protected from flooding, this soil is moderately well suited to corn, soybeans, and small grain. It is farmed along with the adjacent soils, which are more poorly suited to row crops. In some areas the old stream meanders are subject to ponding, which delays fieldwork. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. Deferring tillage

during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

Most of the narrow areas are used as permanent pasture. This soil is well suited to grasses for pasture and hay. It is suited to legumes if an adequate drainage system is installed and flooding is controlled.

Overgrazing or grazing during wet periods causes surface compaction and puddling. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

A few small areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIw.

222C—Clarinda silty clay loam, 5 to 9 percent slopes. This moderately sloping, poorly drained soil is on short, convex side slopes in coves and on some of the lower, narrow ridges near the head of drainageways in the uplands that border major drainage divides. Areas are long and narrow or irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is black, friable silty clay loam about 6 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 5 inches thick. The subsoil to a depth of about 60 inches is mottled silty clay. The upper part is dark gray and is firm and very firm, and the lower part is gray and very firm. In some places the surface layer is thinner because of erosion. In other places the lower part of the subsoil contains less clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Arispe soils and small areas of Clearfield soils. Arispe soils formed in loess. They are on narrow ridges upslope from the Clarinda soil. Clearfield soils formed in 3 to 5 feet of loess, which is underlain by a clayey buried soil. They are near the head of drainageways upslope from the Clarinda soil. The included soils make up about 5 to 15 percent of the unit.

Permeability is very slow in the Clarinda soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of



Figure 8.—Soybeans in an area of Nodaway silt loam, 0 to 2 percent slopes. Many of the old river channel meanders are farmed.

available phosphorus and potassium. Tillth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is poorly suited to intensive row cropping but is suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, the wetness is a very serious limitation and erosion is a severe hazard. Preparing a seedbed is difficult because the soil is wet and seepy for long periods. Growing grasses in the wet and seepy areas can effectively help to control erosion. Erosion can be controlled in row cropped areas by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. In many areas a narrow, seepy band is on the upper part of the side slopes. This band warms up slowly in the spring and dries out very slowly after periods of rainfall. In years of heavy rainfall,

fieldwork is delayed. Tile drainage is not feasible in this very slowly permeable soil, but interceptor tile can be installed on the adjacent soils upslope. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, management is more difficult even if the terrace channel is topdressed with surface soil material.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Management may be difficult because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts

root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

The land capability classification is IVw.

222C2—Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, poorly drained soil is on short, convex side slopes and on some of the lower, narrow ridges near the head of drainageways in the uplands that border major drainage divides. Areas are long and narrow or irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. Plowing has mixed some of the dark gray subsoil with the surface layer. The subsoil to a depth of about 60 inches is mottled silty clay. The upper part is dark gray and is firm and very firm, and the lower part is gray and firm. In places the lower part of the subsoil contains less clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Arispe soils and small areas of Clearfield soils. Arispe soils formed in loess. They are on narrow ridges upslope from the Clarinda soil. Clearfield soils formed in 3 to 5 feet of loess, which is underlain by a clayey buried soil. They are near the head of the drainageways upslope from the Clarinda soil. Also included are the severely eroded Clarinda soils. These soils generally are in areas on shoulder slopes about $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. They have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Clarinda soils. The included soils make up about 5 to 15 percent of the unit.

Permeability is very slow in the Clarinda soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is poorly suited to intensive row cropping but is suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, the wetness is a very serious limitation and water erosion is

a severe hazard. Preparing a seedbed is difficult because the soil is wet and seepy for long periods. Growing grasses in the wet and seepy areas can effectively help to control erosion. In many areas a narrow, seepy band is on the upper part of the side slopes. This band commonly remains wet until midsummer. The soil warms up slowly in the spring and dries out very slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. Tile drainage is not feasible in this very slowly permeable soil, but interceptor tile can be installed on the adjacent soils upslope. Erosion can be controlled in row cropped areas by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, management is more difficult even if the terrace channel is topdressed with surface soil material. More intensive management is needed to maintain fertility on this soil than on the less eroded Clarinda soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Management may be difficult because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

The land capability classification is IVw.

222D—Clarinda silty clay loam, 9 to 14 percent slopes. This strongly sloping, poorly drained soil is on short, convex side slopes in coves near the head of drainageways at the lower elevations in the uplands

that border major drainage divides. Areas are narrow and irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is black, friable silty clay loam about 6 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 4 inches thick. The subsoil to a depth of about 60 inches is mottled silty clay. The upper part is dark gray and is firm and very firm, and the lower part is gray and firm. In some places the surface layer is thinner because of erosion. In other places the lower part of the subsoil contains less clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Arispe soils and small areas of Clearfield soils. Arispe soils formed in loess. They are on ridges upslope from the Clarinda soil. Clearfield soils formed in 3 to 5 feet of loess, which is underlain by a clayey buried soil. They are near the head of drainageways upslope from the Clarinda Soil. The included soils make up about 5 to 15 percent of the unit.

Permeability is very slow in the Clarinda soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is poorly suited to intensive row cropping and small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, the wetness is a serious limitation and water erosion is a severe hazard. Erosion can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. Preparing a seedbed is difficult because the soil is wet and seepy for long periods. Growing grasses in the wet and seepy areas can effectively help to control erosion. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, management is more difficult even if the terrace channel is topdressed with surface soil material. In many areas a narrow, seepy band is on the upper part of the side slopes. This band commonly remains wet until midsummer. The soil warms up slowly in the spring and dries out very slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. Tile drainage is not feasible in this very slowly permeable soil, but interceptor tile can be installed on the adjacent soils upslope.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Management may be difficult because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

The land capability classification is IVe.

222D2—Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, poorly drained soil is on short, convex side slopes in coves near the head of drainageways at the lower elevations in the uplands that border major drainage divides. Areas are narrow and irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is very dark gray, friable and firm silty clay loam about 5 inches thick. Plowing has mixed some of the dark gray subsoil with the surface layer. The subsoil to a depth of about 60 inches is mottled silty clay. The upper part is dark gray and is firm and very firm. The lower part is gray and firm. In some areas the lower part of the subsoil contains less clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Arispe soils and small areas of Clearfield soils. Arispe soils formed in loess. They are on narrow ridges upslope from the Clarinda soil. Clearfield soils formed in 3 to 5 feet of loess, which is underlain by a clayey buried soil. They are near the head of drainageways upslope from the Clarinda soil. Also included are the severely eroded Clarinda soils. These soils generally are in areas on shoulder slopes $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. They have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Clarinda soils. The included soils make up about 5 to 15 percent of the unit.

Permeability is very slow in the Clarinda soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The

shrink-swell potential also is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is poorly suited to intensive row cropping but is suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, the wetness is a serious limitation and water erosion a severe hazard. Erosion can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, management is more difficult even if the terrace channel is topdressed with surface soil material. In many areas a narrow, seepy band is on the upper part of the side slopes. This band commonly remains wet until midsummer. The soil warms up slowly in the spring and dries out very slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. Tile drainage is not feasible in this very slowly permeable soil, but inceptor tile can be installed in the adjacent soils upslope. More intensive management is needed to maintain fertility on this soil than on the less eroded Clarinda soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Management may be difficult because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

The land capability classification is IVe.

269—Humeston silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land along the major streams and along the smaller tributaries. It is occasionally flooded. Areas are irregularly shaped and range from 10 to 400 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 11 inches thick. The subsurface layer is dark gray, mottled, friable silt loam about 14 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is dark gray, friable silty clay loam, and the lower part is very dark gray, firm silty clay. In some places the surface layer is silt loam and has a low content of organic matter. In other places the subsurface layer is darker and contains more clay. In some areas the subsoil contains less clay.

Included with this soil in mapping are small areas that are ponded for long periods. These are areas of shallow surface drains. They have few or no adequate outlets. They make up about 5 to 10 percent of the unit.

Permeability is very slow in the Humeston soil. Runoff is slow or ponded. The seasonal high water table is within a depth of 1 foot. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains.

Most areas are cultivated. If drained and protected from flooding, this soil is suited to corn, soybeans, and small grain. Because permeability is very slow and drainage outlets are not readily available, tile drainage generally cannot work satisfactorily. It should be supplemented by other drainage measures. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. Fall plowing improves the timeliness of fieldwork but increases the susceptibility to soil blowing. Leaving the plowed surface rough and alternating plowed and unplowed strips help to control soil blowing. Chisel plowing, which leaves crop residue on the surface, also helps to control soil blowing. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table and the flooding. Management may be difficult because the soil is poorly drained. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the extent of ponding. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIIw.

269+—Humeston silt loam, overwash, 0 to 2

percent slopes. This nearly level, poorly drained soil is on second bottoms along the major streams and along the smaller tributaries. It is occasionally flooded. Areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is stratified dark yellowish brown and dark grayish brown, friable silt loam about 12 inches thick. Below this is a buried surface layer of very dark gray, friable silty clay loam about 11 inches thick. The subsurface layer is dark gray, mottled, friable silt loam. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is dark gray and gray, friable silty clay loam, and the lower part is very dark gray, firm silty clay. In some places the buried surface layer is darker and contains more clay. In other places the subsoil contains less clay.

Included with this soil in mapping are small areas that are ponded for long periods. These are areas of shallow surface drains. They have few or no adequate outlets. They make up about 5 to 10 percent of the unit.

Permeability is very slow in the Humeston soil. Runoff is slow. The seasonal high water table is within a depth of 1 foot. The available water capacity is high. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. If drained and protected from flooding, this soil is suited to corn, soybeans, and small grain. Because permeability is very slow and drainage outlets are not readily available, tile drainage generally cannot work satisfactorily. It should be

supplemented by other drainage measures. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. Fall plowing improves the timeliness of fieldwork but increases the susceptibility to soil blowing. Leaving the plowed surface rough and alternating plowed and unplowed strips help to control soil blowing. Chisel plowing, which leaves crop residue on the surface, also helps to control soil blowing. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table and the flooding. Management may be difficult because the soil is poorly drained. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the extent of ponding. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIIw.

269B—Humeston silty clay loam, 2 to 5 percent slopes.

This gently sloping, poorly drained soil is on low, slightly concave foot slopes and alluvial fans. It is directly downslope from the moderately sloping soils on side slopes that formed in valley fill and upslope from broad, nearly level bottom land. It is subject to rare flooding. Areas are long and narrow and range from 4 to 10 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 11 inches thick. The subsurface layer is dark gray, mottled, friable silt loam about 14 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is dark gray and gray, friable silty clay loam, and the lower part is very



Figure 9.—Soybeans in an area of Humeston silty clay loam, 2 to 5 percent slopes.

dark gray, firm silty clay. In some places the surface layer is silt loam and has a low content of organic matter. In other places the subsurface layer is darker and contains more clay. In some areas the subsoil contains less clay.

Permeability is very slow. Runoff is medium. The seasonal high water table is within a depth of 1 foot. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated (fig. 9). If drained, this soil is suited to corn, soybeans, and small grain. Because of the very slow permeability, tile drainage generally cannot work satisfactorily. It should be supplemented by

other drainage measures. In many areas diverting runoff from the soils upslope can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. If cultivated crops are grown, erosion is a slight hazard. Contour stripcropping and a system of conservation tillage that leaves crop residue on the surface help to prevent excessive soil loss. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the last 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Management may be difficult because the soil is poorly drained and occasionally flooded. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIIw.

269B+—Humeston silt loam, overwash, 2 to 5 percent slopes. This gently sloping, poorly drained soil is on low, slightly concave foot slopes and alluvial fans. It is directly downslope from the moderately sloping soils on side slopes that formed in valley fill and upslope from broad, nearly level bottom land. It is subject to rare flooding. Areas are long and narrow and range from 4 to 10 acres in size.

Typically, the surface layer is stratified brown and very dark gray, friable silt loam about 9 inches thick. Below this is a buried surface layer of friable silty clay loam about 11 inches thick. The subsurface layer is dark gray, mottled, friable silt loam about 14 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled. The upper part is dark gray and gray, friable silty clay loam, and the lower part is very dark gray, firm silty clay. In some places the subsurface layer is darker and contains more clay. In other places the subsoil contains less clay.

Permeability is very slow. Runoff is medium. The seasonal high water table is within a depth of 1 foot. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. If drained, this soil is suited to corn, soybeans, and small grain. Because of the very slow permeability, tile drainage generally cannot work satisfactorily. It should be supplemented by other drainage measures. In many areas diverting runoff from the soils upslope can improve crop

production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. If cultivated crops are grown, erosion is a hazard. Siltation can hinder the establishment of seedlings. Contour strip cropping and a system of conservation tillage that leaves crop residue on the surface help to prevent excessive soil loss. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table. Management may be difficult because the soil is poorly drained and occasionally flooded. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIIw.

273B—Olmitz loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on low, slightly concave foot slopes and on convex alluvial fans. It is directly downslope from the moderately steep or steep soils on side slopes that formed in glacial till. Areas are long and narrow and range from 5 to 10 acres in size.

Typically, the surface layer is black and very dark brown, friable loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable loam about 20 inches thick. The subsoil to a depth of about 60 inches is clay loam. The upper part is dark brown and friable; the next part is brown, mottled, and friable; and the lower part is brown, mottled, and friable and firm. In places the subsoil is grayer.

Included with this soil in mapping are small areas of Gara and Shelby soils. These soils formed in glacial till. They are higher on the landscape than the Olmitz soil

and are more sloping. They make up about 5 to 10 percent of the unit.

Permeability is moderate in the Olmitz soil. Runoff is medium. The available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil has a very low supply of available phosphorus and a low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain. Because it is mainly in small areas, it generally is farmed along with the adjacent soils, which are more poorly suited to row crops. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, erosion is a hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, diversion terraces, contour farming, grassed waterways, and crop rotations that include grasses and legumes. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIe.

273C—Olmitz loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on low, slightly concave foot slopes and on convex alluvial fans. It is directly downslope from soils on side slopes that formed in glacial till and upslope from broad, nearly level alluvial bottom land. Areas are long and narrow and range from 5 to 15 acres in size.

Typically, the surface layer is black and very dark brown, friable loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable loam about 18 inches thick. The subsoil to a depth of about 60 inches is clay loam. The upper part is dark brown and friable, and the lower part is brown, mottled, and friable. In places the subsoil is grayer.

Included with this soil in mapping are small areas of Gara and Shelby soils. These soils formed in glacial till. They are higher on the landscape than the Olmitz soil and are more sloping. They make up about 5 to 10 percent of the unit.

Permeability is moderate in the Olmitz soil. Runoff is medium. The available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil has a very low supply of available phosphorus and a low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. Some areas are used as pasture. This soil is suited to corn, soybeans, and small grain. Because it is mainly in small areas, it generally is farmed along with the adjacent soils, which are more poorly suited to row crops. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, erosion is a hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, diversion terraces, contour farming, grassed waterways, and crop rotations that include grasses and legumes. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses and legumes for hay and is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

287B—Zook-Ely silty clay loams, 0 to 5 percent slopes. These nearly level and gently sloping soils are in narrow drainageways that extend from the uplands to small streams. The poorly drained Zook soil is on bottom land near stream channels. It is occasionally flooded. The somewhat poorly drained Ely soil is on low, slightly concave foot slopes. Areas are long and narrow and range from 10 to more than 100 acres in size. They are about 55 percent Zook soil and 35

percent Ely soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Zook soil has a surface layer of black, friable silty clay loam about 9 inches thick. The subsurface layer is about 27 inches thick. The upper part is black, friable silty clay loam; the next part is black, firm silty clay; and the lower part is very dark gray, firm silty clay. The subsoil is dark gray, firm silty clay about 14 inches thick. The substratum to a depth of about 60 inches is gray, mottled silty clay. In places the surface layer is silt loam and has a low content of organic matter.

Typically, the Ely soil has a surface layer of black, friable silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray, friable silty clay loam about 17 inches thick. The subsoil is friable and firm silty clay loam about 22 inches thick. The upper part is very dark grayish brown, the next part is dark grayish brown and mottled, and the lower part is mottled yellowish brown and grayish brown. The substratum to a depth of about 60 inches is mottled light brownish gray, strong brown, and gray silty clay loam.

Included with these soils in mapping are small areas of the moderately well drained, stratified Nodaway soils near the stream channels. These included soils have a lower content of organic matter in the surface layer than the Zook and Ely soils. They make up about 10 percent of the unit.

Permeability is slow in the Zook soil and moderate in the Ely soils. Runoff is slow on the Zook soil and medium on the Ely soil. The Ely soil has a seasonal high water table at a depth of 2 to 4 feet, and the Zook soil has one within a depth of 3 feet. The available water capacity is very high in the Ely soil and moderate in the Zook soil. The shrink-swell potential is high in the Zook soil. The content of organic matter is about 5 to 7 percent in the surface layer of the Zook soil and about 5 to 6 percent in the surface layer of the Ely soil. The supply of available phosphorus generally is medium in the subsoil of the Zook soil and low in the subsoil of the Ely soil. The supply of available potassium is low in both soils. Tilth is fair in the Zook soil and good in the Ely soil. Both soils tend to puddle if worked when wet.

Most areas are managed along with the adjacent soils as cropland, pasture, or hayland. If drained and protected from runoff, these soils are moderately well suited to corn, soybeans, and small grain. Many areas are dissected by waterways that cannot be crossed by machinery. Areas near small streams are subject to flooding for short periods. Terraces, contour stripcropping, a system of conservation tillage that leaves crop residue on the surface, grassed waterways,

and contour farming on the soils upslope reduce the hazard of gully erosion on these soils and minimize flooding. Tile drainage is needed in the grassed waterways to remove excess water. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soils or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

These soils are well suited to grasses for hay. The Zook soil is suited to pasture, and the Ely soil is moderately well suited. Both soils are poorly suited to legumes because of the seasonal high water table and the flooding. Management may be difficult because the soils are poorly drained or somewhat poorly drained. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands may be needed to protect these soils from flooding. Overgrazing or grazing when the soils are too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is 1lw.

362—Haig silty clay loam, 0 to 2 percent slopes.

This nearly level, poorly drained soil is on broad upland flats. Areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsurface layer also is black, friable silty clay loam. It is about 11 inches thick. The subsoil extends to a depth of about 60 inches. It is mottled and firm. The upper part is very dark gray silty clay, the next part is dark gray silty clay, and the lower part is light brownish gray silty clay and silty clay loam. In places the subsurface layer is dark gray.

Included with this soil in mapping are small depressional areas of Edina soils. These soils are seasonally wetter than the Haig soil and may be ponded for short periods. They make up about 5 to 10 percent of the unit.

Permeability is slow in the Haig soil. Runoff is very slow. The available water capacity is high. The seasonal high water table is at a depth of 1 to 2 feet. The shrink-swell potential is high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is fair. The

soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain. If the soil is drained, row crops can be grown in many years. Tile drainage generally does not work satisfactorily because permeability is slow and drainage outlets are not readily available. A surface drainage system can effectively remove the excess surface water. In many areas fieldwork is delayed because the soil warms up slowly in the spring and dries out slowly after periods of rainfall. If rainfall is heavy, planting also is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. The ridge system should allow excess water to drain off of the soil. Fall plowing improves the timeliness of fieldwork but increases the susceptibility to soil blowing. Leaving the plowed surface rough and alternating plowed and unplowed strips help to control soil blowing. Chisel plowing, which leaves crop residue on the surface, also helps to control soil blowing. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table. Management may be difficult because the soil is poorly drained. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the extent of ponding. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is 1lw.

364B—Grundy silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on convex ridgetops and short side slopes in the uplands. Areas are irregular in shape or long and narrow and may extend for several miles. They range from 5 to 160 acres in size.

Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsurface layer also is black, friable silty clay loam. It is about 6 inches thick. The subsoil extends to a depth of about 60 inches. The

upper part is dark grayish brown, friable silty clay loam; the next part is dark grayish brown and grayish brown, mottled, firm silty clay; and the lower part is grayish brown and light brownish gray, firm silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Haig soils on the less sloping parts of the landscape. These soils are seasonally wetter than the Grundy soil. They make up about 5 to 10 percent of the unit.

Permeability is slow in the Grundy soil. Runoff is medium. The available water capacity is high. The seasonal high water table is at a depth of 1.5 to 3.0 feet. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard in the more sloping areas. Row crops can be grown in most years if erosion is controlled. A system of conservation tillage that leaves crop residue on the surface, contour farming, contour stripcropping, and terraces help to prevent excessive soil loss. In places contour farming, stripcropping, or terracing is difficult because of undulating, short slopes. Terrace cuts should not expose the firm, clayey subsoil. If the subsoil is exposed, working the soil is difficult and terrace channels may become seepy. A combination of tile drainage and terraces can help to control erosion and improve the timeliness of fieldwork in years when rainfall is above normal. Grassed waterways help to prevent gully erosion. This slowly permeable soil tends to warm up more slowly in the spring than the more permeable soils, and it dries out more slowly after periods of rainfall. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture

rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

The land capability classification is 11e.

368B—Macksburg silty clay loam, 1 to 5 percent slopes. This very gently sloping and gently sloping, somewhat poorly drained soil is on convex ridgetops and short, convex side slopes in the uplands. Areas are irregular in shape or long and narrow and may extend for several miles. They range from 5 to 160 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown, friable silty clay loam about 7 inches thick. The subsurface layer is very dark gray and very dark grayish brown, friable and firm silty clay loam about 11 inches thick. The subsoil to a depth of about 60 inches is silty clay loam. The upper part is brown and firm; the next part is grayish brown, mottled, and firm and friable; and the lower part is grayish brown, mottled, and friable. In some places the mottles in the subsoil are below a depth of 24 inches. In other places the upper part of the subsoil is dominantly dark grayish brown.

Included with this soil in mapping are small areas of the poorly drained Clearfield soils. These soils are grayer in the subsoil than the Macksburg soil and are underlain by a gray, clayey paleosol. They are seasonally wet and are near the head of drainageways. They make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Macksburg soil. Runoff is medium. The available water capacity is very high. The seasonal high water table is at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 4.5 to 5.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard in the more sloping areas. Row crops can be grown in most years if erosion is controlled. A system of conservation tillage that leaves crop residue on the surface, contour farming, contour stripcropping, and terraces help to prevent excessive soil loss. A combination of terraces and tile drainage improves the timeliness of fieldwork in years when rainfall is above normal and helps to control

erosion. Grassed waterways help to prevent gully erosion. This slowly permeable soil tends to warm up more slowly in the spring than the more permeable soils, and it dries out more slowly after periods of rainfall. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, preparing a seedbed and interseeding on the contour help to control erosion.

The land capability classification is 11e.

369—Winterset silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad upland flats. Areas are irregular in shape and range from 5 to 60 acres in size.

Typically, the surface layer is black, friable silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray, mottled, friable silty clay loam about 10 inches thick. The subsoil is about 33 inches thick. The upper part is dark gray, mottled, firm silty clay; the next part is grayish brown, firm silty clay; and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam. In some areas the subsurface layer is dark gray, friable silt loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Macksburg soils on the more convex, sloping parts of the landscape. These soils are browner in the subsoil than the Winterset soil. Also included, in small depressional areas, are soils that have a gray subsurface layer. These soils are seasonally wetter than the Winterset soil and may be ponded for short periods. The included soils make up

about 5 to 10 percent of the unit.

Permeability is moderately slow in the Winterset soil. Runoff is slow. The available water capacity is high. The seasonal high water table is at a depth of 1 to 2 feet. The shrink-swell potential is high. The content of organic matter is about 5 to 6 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain. Fieldwork generally is delayed because the soil warms up slowly in the spring and dries out slowly after periods of heavy rainfall. A tile drainage system improves the timeliness of fieldwork in years when rainfall is above normal. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. The ridge system should allow excess water to drain off of the soil. Fall plowing improves the timeliness of fieldwork but increases the susceptibility to soil blowing. Leaving the plowed surface rough and alternating plowed and unplowed strips help to control soil blowing. Chisel plowing, which leaves crop residue on the surface, also helps to control soil blowing. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table. Management may be difficult because the soil is poorly drained. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the extent of ponding. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is 1lw.

370B—Sharpsburg silty clay loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and short, convex side slopes in the uplands. Areas are irregular in shape or long and

narrow and may extend as much as 1½ miles. They range from 5 to 80 acres in size.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 9 inches thick. The subsoil to a depth of about 60 inches is silty clay loam. The upper part is dark brown and friable; the next part is brown and grayish brown, mottled, and firm; and the lower part is grayish brown, mottled, and friable. In places a grayish brown color and mottles are as shallow as 24 inches.

Permeability is moderately slow. Runoff is medium. The seasonal high water table is at a depth of 4 to 6 feet. The available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, terraces, crop rotations that include grasses and legumes, and contour stripcropping or by a combination of these measures. Grassed waterways help to prevent gully erosion. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is 1le.

370C—Sharpsburg silty clay loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on the slightly lower, narrow ridgetops and on short, convex side slopes in the uplands. Areas



Figure 10.—Terraces and stripcropping in an area of Sharpsburg silty clay loam, 5 to 9 percent slopes.

are long and narrow or irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is black, friable silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 4 inches thick. The subsoil is silty clay loam about 40 inches thick. The upper part is brown and friable; the next part is brown, mottled, and firm; and the lower part is grayish brown, mottled, and friable. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam. In places the surface layer is thinner because of erosion. In some areas a grayish brown color and mottles are as shallow as 24 inches.

Permeability is moderately slow. Runoff is medium. The seasonal high water table is at a depth of 4 to 6 feet. The available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a medium supply of

available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are used for row crops. This soil is moderately well suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. It can be controlled by contour farming, contour stripcropping, terraces (fig. 10), a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses and legumes for hay and is well suited to pasture.

Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

370C2—Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on the slightly lower, narrow ridgetops and on short, convex side slopes in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 15 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 7 inches thick. Plowing has mixed some of the brown subsoil with the surface layer. The subsoil is silty clay loam about 37 inches thick. The upper part is brown and is friable and firm; the next part is brown and mottled; and the lower part is grayish brown, mottled, and friable. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam. In some areas a grayish brown color and mottles are as shallow as 24 inches.

Permeability is moderately slow. Runoff is medium. The seasonal high water table is at a depth of 4 to 6 feet. The available water capacity is high. The content of organic matter is about 2.7 to 3.7 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain. If cultivated crops are grown, water erosion is a hazard. It can be controlled, however, by a system of conservation tillage that leaves crop residue on the surface, contour farming, terraces, crop rotations that include grasses and legumes, and contour stripcropping or by a combination of these measures. Deferring tillage during wet periods minimizes compaction and improves tilth. More intensive management is needed to maintain fertility on this soil than on the less eroded Sharpsburg soils. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth, helps to control erosion, and increases the rate of water infiltration. Lime generally is needed if it has not been

applied in the past 3 to 5 years.

This soil is moderately well suited to grasses and legumes for hay and is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

370D—Sharpsburg silty clay loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on convex side slopes in the uplands. Areas typically are long and narrow and range from 5 to 15 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 3 inches thick. The subsoil is mottled silty clay loam about 37 inches thick. The upper part is brown, the next part is brown and firm, and the lower part is grayish brown and friable. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam. In some places the surface layer is thinner. In other places a grayish brown color and mottles are as shallow as 24 inches.

Permeability is moderately slow. Runoff is rapid. The seasonal high water table is at a depth of 4 to 6 feet. The available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain. Because it is mainly in small areas, it generally is farmed along with soils that are more poorly suited to row crops. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and crop rotations that include meadow crops. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or

regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses and legumes for hay and is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

423C—Bucknell silty clay loam, 5 to 9 percent slopes. This moderately sloping, somewhat poorly drained soil is on short, convex side slopes, which are near the upper ends of drainageways, and on the lower, narrow ridges in the uplands that border major drainage divides. Areas are irregularly shaped and range from 4 to 25 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 9 inches thick. The subsoil is about 38 inches thick. It is mottled. The upper part is dark grayish brown, friable clay loam; the next part is dark gray, firm clay; and the lower part is gray, firm clay loam. The substratum to a depth of about 60 inches is mottled gray, yellowish brown, and strong brown clay loam. In places the surface layer is thinner because of erosion.

Included with this soil in mapping are small areas of poorly drained soils. These soils are higher on the landscape than the Bucknell soil. Also, they have a thicker layer of clay. They make up about 5 to 15 percent of the unit.

Permeability is slow in the Bucknell soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture. This soil is suited to corn and soybeans. It is better suited to small grain.

Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay and pasture plants is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

Many areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard.

The land capability classification is IIIe.

423C2—Bucknell silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained soil is on short, convex side slopes, which are near the upper ends of drainageways, and on the lower, narrow ridges in the uplands that border major drainage divides. Areas are irregularly shaped and range from 4 to more than 25 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. Plowing has mixed some of the dark grayish brown subsoil with the surface layer. The subsoil is about 37 inches thick. It is mottled. The upper part is dark grayish brown, friable clay loam; the next part is dark gray, firm clay; and the lower part is gray, firm clay loam. The substratum to a depth of about 60 inches is mottled gray, yellowish brown, and strong brown clay loam.

Included with this soil in mapping are small areas of poorly drained soils. These soils are higher on the landscape than the Bucknell soil. Also, they have a thicker layer of clay. Also included are the severely eroded Bucknell soils, which generally are in scattered areas about $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. These soils have a low content of organic matter and have clay mixed in the plow layer. More intensive management is needed to maintain fertility on these soils than on the less eroded Bucknell soils. The included soils make up about 5 to 15 percent of the unit.

Permeability is slow in the Bucknell soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are cultivated. This soil is suited to corn and soybeans. It is better suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, water erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. More intensive management is needed to maintain fertility on this soil than on the less eroded Bucknell soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table.

Maintaining a cover of hay and pasture plants is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

A few small areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard.

The land capability classification is IIIe.

423D—Bucknell silty clay loam, 9 to 14 percent slopes. This strongly sloping, somewhat poorly drained soil is on short, convex side slopes and shoulder slopes, which are near the upper ends of upland drainageways, and on the lower elevations along the major drainage divides. Areas are irregularly shaped and range from 4 to 25 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 8 inches thick. The subsoil is about 38 inches thick. The upper part is dark grayish brown, mottled, friable clay loam; the next part is dark gray and gray, mottled, firm clay; and the lower part is grayish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is mottled gray, yellowish brown, and strong brown clay loam. In places the surface layer is thinner because of erosion.

Included with this soil in mapping are small areas of poorly drained soils. These soils are higher on the landscape than the Bucknell soil. Also, they have a thicker layer of clay. They make up about 5 to 15 percent of the unit.

Permeability is slow in the Bucknell soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.5 to 3.5 percent in the surface

layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture. This soil is poorly suited to intensive row cropping but is suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, water erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay and pasture plants is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

Many areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard.

The land capability classification is IVe.

423D2—Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on short, convex side slopes and shoulder slopes, which are near the upper ends of upland drainageways, and on the lower elevations along the major drainage divides. Areas are irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 5 inches thick. Plowing has mixed some of the dark grayish brown subsoil with the surface layer. The subsoil is about 35 inches thick. The upper part is dark grayish brown, mottled, friable loam; the next part is dark gray and gray, mottled, firm clay; and the lower part is gray, mottled, firm clay loam. The substratum to a depth of about 60 inches is gray, yellowish brown, and strong brown clay loam.

Included with this soil in mapping are small areas of poorly drained soils. These soils are higher on the landscape than the Bucknell soil. Also, they have a thicker layer of clay. Also included are the severely eroded Bucknell soils, which generally are in scattered areas about ¼ to ½ acre in size. These soils have a low content of organic matter and have clay mixed in the plow layer. More intensive management is needed to maintain fertility on these soils than on the less eroded Bucknell soils. The included soils make up about 5 to 15 percent of the unit.

Permeability is slow in the Bucknell soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are cultivated. This soil is poorly suited to intensive row cropping but is suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, water erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes help to prevent excessive soil loss. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. More intensive management is needed to maintain fertility on this soil than on the less eroded Bucknell soils. Deferring tillage during wet periods minimizes compaction and improves tilth.

Returning crop residue to the soil or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay and pasture plants is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

A few small areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard.

The land capability classification is IVe.

425C—Keswick silt loam, 5 to 9 percent slopes.

This moderately sloping, moderately well drained soil is on the lower, narrow ridges and short, convex side slopes in the uplands. Areas are long and narrow and range from 4 to 10 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is brown, friable silt loam about 6 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is brown, friable clay loam; the next part is reddish brown and strong brown, mottled, firm clay; and the lower part is mottled yellowish brown, light brownish gray, and strong brown, firm clay loam. In some places the subsoil is grayer and has a thicker layer of clay. In other places the surface soil is thinner and has a low content of organic matter.

Permeability is slow. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell

potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as woodland or pasture. This soil is suited to corn and soybeans. It is better suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 4 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce

the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IIIe.

425D—Keswick silt loam, 9 to 14 percent slopes.

This strongly sloping, moderately well drained soil is on short, convex side slopes, on shoulder slopes, and on the lower, narrow ridges in the uplands. Areas are irregularly shaped or long and narrow and range from 5 to 20 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 3 inches thick. The subsurface layer is brown, friable silt loam about 6 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is brown, friable clay loam; the next part is reddish brown and strong brown, mottled, firm clay; and the lower part is mottled yellowish brown, light brownish gray, and strong brown, firm clay loam. In some places the subsoil is grayer and has a thicker layer of clay. In other places the surface soil is thinner and has a low content of organic matter.

Permeability is slow. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as woodland or pasture. This soil is poorly suited to row crops. It is better suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes help to prevent excessive soil loss. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 or 4 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion.

The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture.

Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IVe.

428B—Ely silty clay loam, 2 to 5 percent slopes.

This gently sloping, somewhat poorly drained soil is on low, slightly concave foot slopes and alluvial fans. It is directly downslope from moderately sloping soils on side slopes, which generally formed in loess, and upslope from broad, nearly level bottom land. Areas are long and narrow and range from 4 to 10 acres in size.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray, friable silty clay loam about 17 inches thick. The subsoil is friable and firm silty clay loam about 22 inches thick. The upper part is very dark grayish brown, the next part is dark grayish brown and mottled, and the lower part is mottled yellowish brown and grayish brown. The substratum to a depth of about 60 inches is mottled light brownish gray, strong brown, dark grayish brown, and gray silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Zook soils. These soils are near the major drainageways downslope from the Ely soil. They make up about 5 to 15 percent of the unit.

Permeability is moderate in the Ely soil. Runoff is medium. The seasonal high water table is at a depth of 2 to 4 feet. The available water capacity is very high. The content of organic matter is about 5 to 6 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain. Tile drainage generally is needed to reduce the wetness during the spring. Because this soil is subject to erosion, diversion terraces are needed on the soils upslope to control runoff and erosion. In many areas diverting runoff from the soils upslope can improve crop production and minimize siltation. Erosion can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes.

This soil is well suited to grasses for hay and is moderately well suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

The land capability classification is IIe.

430—Ackmore silt loam, 0 to 2 percent slopes.

This nearly level, somewhat poorly drained soil is on bottom land and on the lower part of alluvial fans. It is occasionally flooded. Areas are elongated and range from 10 to 80 acres in size.

Typically, the surface layer is stratified very dark gray and very dark grayish brown, friable silt loam about 8 inches thick. The substratum is stratified very dark gray, very dark grayish brown, and grayish brown, mottled silt loam about 24 inches thick. Below this to a depth of about 60 inches is a buried surface layer of black and very dark gray, friable and firm silty clay loam. In places the surface layer is loam. In some areas the black buried surface layer is at a depth of more than 40 inches.

Permeability is moderate. Runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is very high. The content of the organic matter is about 1 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and a very low supply of available

potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. If drained and protected from flooding, this soil is moderately well suited to corn, soybeans, and small grain. Tile drainage generally cannot work satisfactorily unless adequate outlets are available and the silty alluvial material is thick enough for the drainage tile to be installed on top of the buried soil. A tile drainage system generally does not work satisfactorily in the buried soil because of restricted permeability. Open ditches and surface drains can effectively remove excess surface water. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. Fall plowing improves the timeliness of fieldwork but increases the susceptibility to soil blowing. Leaving the plowed surface rough and alternating plowed and unplowed strips help to control soil blowing. Chisel plowing, which leaves crop residue on the surface, also helps to control soil blowing. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses for hay and pasture. It is poorly suited to legumes, however, because of the seasonal high water table and the flooding. Management may be difficult because the soil is somewhat poorly drained and is occasionally flooded. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands may be needed to protect this soil from flooding. Overgrazing or grazing during wet periods causes surface compaction and puddling. Pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

A few small areas support native hardwoods. This soil is moderately well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIw.

451D2—Caleb loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on the short, convex side slopes of the escarpments on high stream benches and on some concave foot slopes in the uplands. Areas are long and narrow and range from 4 to 10 acres in size.

Typically, the surface layer is very dark grayish brown and dark brown, friable loam about 6 inches thick. Plowing has mixed some of the dark yellowish brown subsoil with the surface layer. The subsoil is about 43 inches thick. The upper part is dark yellowish brown and yellowish brown, firm clay loam; the next part is yellowish brown, mottled, friable sandy clay loam; and the lower part is yellowish brown, mottled, friable sandy loam. The substratum to a depth of about 60 inches is mottled brown, strong brown, and grayish brown sandy clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Mystic soils. These soils are on the upper parts of the side slopes. Also included are the severely eroded Caleb soils, which generally are in scattered areas about ¼ to ½ acre in size. These soils have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Caleb soils. The included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Caleb soil. Runoff is rapid. The seasonal high water table is at a depth of 3 to 5 feet. The available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

This soil is used mainly for pasture or hay. It is poorly suited to corn and soybeans. It is better suited to small grain. If cultivated crops are grown, water erosion is a very severe hazard. Row crops can be grown if erosion is controlled. Contour farming, grassed waterways, crop rotations that include grasses and legumes, and a system of conservation tillage that leaves crop residue on the surface help to control erosion. Intensive cultivation is not recommended because of an excessive rate of soil loss on this strongly sloping soil. More intensive management is needed to maintain fertility on this soil than on the less eroded Caleb soils. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to maintain tilth, minimizes crusting, and increases the rate of water infiltration. Lime generally is

needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay and is well suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

A few small areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

451F2—Caleb loam, 14 to 25 percent slopes, moderately eroded. This moderately steep and steep, moderately well drained soil is on the short, convex side slopes of the escarpments on high stream benches. Areas are long and narrow and range from 4 to 10 acres in size.

Typically, the surface layer is brown and very dark grayish brown, friable loam about 5 inches thick. Plowing has mixed some of the dark yellowish brown subsoil with the surface layer. The subsoil is about 38 inches thick. The upper part is dark yellowish brown and yellowish brown, firm clay loam; the next part is yellowish brown, mottled, friable sandy clay loam; and the lower part is yellowish brown, mottled, friable sandy loam. The substratum to a depth of about 60 inches is mottled brown, strong brown, and grayish brown sandy clay loam.

Included with this soil in mapping are the severely eroded Caleb soils, which generally are in scattered areas about ¼ to ½ acre in size. These soils have a low content of organic matter. More intensive management is needed to maintain fertility on these

soils than on the less eroded Caleb soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Caleb soil. Runoff is very rapid. The seasonal high water table is at a depth of 3 to 5 feet. The available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture. This soil generally is unsuited to cultivated crops. Because the soil is on moderately steep and steep, irregular side slopes and is marginally productive, it is best suited to grasses and trees, which help to control erosion. Intensive cultivation is not recommended because of an excessive rate of soil loss. More intensive management is needed to maintain fertility on this soil than on the less eroded Caleb soils.

This soil is poorly suited to grasses and legumes for hay and is moderately well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

This soil is suited to trees. Carefully locating logging trails or roads and laying out the trails and roads on the contour or nearly on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. Special equipment can be used. Caution is needed in operating the equipment. Seedlings survive and grow well.

The land capability classification is VIIe.

452C—Lineville silt loam, 5 to 9 percent slopes.

This moderately sloping, somewhat poorly drained soil is on the slightly lower, narrow ridges in the uplands. Areas are long and narrow and range from 3 to 10 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil extends to a depth of

about 60 inches. The upper part is dark brown and dark yellowish brown, friable silty clay loam; the next part is brown, yellowish brown, and dark yellowish brown, mottled, friable and firm loam; and the lower part is mottled strong brown and brown, firm clay loam and clay. In areas dominated by prairie grasses, the surface soil is thicker and darker.

Included with this soil in mapping are small areas of Armstrong and Pershing soils. Armstrong soils formed in weathered glacial till and contain more clay than the Lineville soil. They are on narrow interfluvies and side slopes downslope from the Lineville soil. Pershing soils formed in loess and contain less sand than the Lineville soil. They are on the broader ridgetops upslope from the Lineville soil. The included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Lineville soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used for hay or pasture. Because it is mainly in small areas, this soil generally is managed along with the adjacent soils. It is suited to corn and soybeans. It is better suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, contour stripcropping, and crop rotations that include grasses and legumes. Terrace cuts should not expose the clayey subsoil, which is low in fertility and in places is at a depth of 2 to 3 feet. Topdressing with a surface soil material helps to establish seedlings in areas where the subsoil is exposed. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage

production can be reduced if rainfall is not adequate or timely. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

A few small areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

452C2—Lineville silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained soil is on the slightly lower, narrow ridges in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 20 acres in size.

Typically, the surface layer is dark grayish brown and very dark grayish brown, friable silt loam about 6 inches thick. Plowing has mixed some of the dark brown subsoil with the surface layer. The subsoil extends to a depth of about 60 inches. The upper part is dark brown, friable loam; the next part is brown, yellowish brown, and dark yellowish brown, mottled, friable and firm loam; and the lower part is mottled strong brown and brown, firm clay. In areas dominated by prairie grasses, the surface layer is darker.

Included with this soil in mapping are small areas of Armstrong and Pershing soils. Armstrong soils formed in weathered glacial till and contain more clay than the Lineville soil. They are on narrow interfluvies and side slopes downslope from the Lineville soil. Pershing soils formed in loess and contain less sand than the Lineville soil. They are on the broader ridgetops upslope from the Lineville soil. The included soils make up 5 to 15 percent of the unit.

Permeability is slow in the Lineville soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The

soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used for hay or pasture. Some areas were cultivated in the past. Because it is mainly in small areas, this soil generally is farmed along with the adjacent soils. It is suited to corn and soybeans. It is better suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, water erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, contour strip cropping, and crop rotations that include grasses and legumes. Terrace cuts should not expose the clayey subsoil, which is low in fertility and in places is at a depth of 2 to 3 feet. Topdressing with a surface soil material helps to establish seedlings in areas where the subsoil is exposed. More intensive management is needed to maintain fertility on this soil than on the less eroded Lineville soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is poorly suited to legumes, however, because of the seasonal high water table. Maintaining a cover of grasses and legumes is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

470D—Lamoni-Shelby complex, 9 to 14 percent slopes. These strongly sloping soils are on uplands. The somewhat poorly drained Lamoni soil is on the upper, convex or slightly concave side slopes, on shoulder slopes, and on narrow ridges, and the well drained Shelby soil is on the lower, convex side slopes near the upper ends of drainageways. Areas are irregularly shaped and range from 5 to 10 acres in size. They are about 70 percent Lamoni soil and 30 percent Shelby soil. The two soils occur as areas so small that mapping them separately is impractical.

Typically, the Lamoni soil has a surface layer of black, friable silty clay loam about 10 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark grayish brown and grayish brown, mottled, firm clay; the next part is mottled yellowish brown and light gray, firm clay; and the lower part is mottled yellowish brown and light gray, firm clay loam.

Typically, the Shelby soil has a surface layer of very dark grayish brown, friable clay loam about 8 inches thick. The subsurface layer is dark brown, friable clay loam about 4 inches thick. The subsoil is clay loam about 31 inches thick. The upper part is brown and friable; the next part is yellowish brown and firm; and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. It has white nodules of calcium carbonate. In some places the surface layer is thicker and darker. In other places it is thinner because of erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Permeability is slow in the Lamoni soil and moderately slow in the Shelby soil. Runoff is rapid on both soils. The Lamoni soil has a seasonal high water table at a depth of 1 to 3 feet. The available water capacity is high in both soils. The Lamoni soil has a high shrink-swell potential. The content of organic matter is about 3 to 4 percent in the surface layer of both soils. The soils generally have a very low supply of available phosphorus in the subsoil. The subsoil of the Lamoni soil generally has a low supply of available potassium, and that of the Shelby soil has a very low supply. Tilth is good in both soils. The soils tend to puddle if worked when wet.

Most areas are cultivated. Some areas are used as pasture. In most areas these soils are managed along with the adjacent soils. They are poorly suited to corn and small grain. Conservation measures are needed on these soils and on the soils upslope. If cultivated crops are grown, erosion is a hazard. Row crops should be grown only to establish a pasture. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and contour stripcropping

help to prevent excessive soil loss. If terraces are constructed, the cuts should not expose the firm subsoil, which is low in fertility. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soils or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

These soils are suited to grasses for hay. The Lamoni soil is poorly suited to pasture and to legumes for hay because of the seasonal high water table. The Shelby soil is well suited to pasture and is suited to legumes for hay. Growing grasses and legumes for hay and pasture is effective in controlling erosion. Management may be difficult because the Lamoni soil is periodically wet and seepy. Planting forage species that are tolerant of the wetness in the Lamoni soil can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay and grasses for pasture on the Lamoni soil. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soils are wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion.

The land capability classification is IVe.

470D2—Lamoni-Shelby complex, 9 to 14 percent slopes, moderately eroded. These strongly sloping soils are on uplands. The somewhat poorly drained Lamoni soil is on the upper, convex or slightly concave side slopes, on shoulder slopes, and on narrow ridges. The well drained Shelby soil is on the lower, convex nose slopes and side slopes near the upper ends of drainageways. Areas are irregularly shaped and range from 5 to 10 acres in size. They are about 65 percent Lamoni soil and 30 percent Shelby soil. The two soils occur as areas so small that mapping them separately is impractical.

Typically, the Lamoni soil has a surface layer of very dark gray, friable silty clay loam about 5 inches thick. Plowing has mixed some of the dark grayish brown subsoil with the surface layer. The subsoil extends to a depth of about 60 inches. The upper part is grayish

brown and dark grayish brown, mottled, firm clay; the next part is mottled yellowish brown and light gray, firm clay; and the lower part is mottled light gray and yellowish brown, firm clay loam.

Typically, the Shelby soil has a surface layer of very dark grayish brown, friable clay loam about 8 inches thick. Plowing has mixed some of the brown subsoil with the surface layer. The subsoil is clay loam about 30 inches thick. The upper part is brown and friable; the next part is yellowish brown, mottled, and firm; and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled, calcareous clay loam. It has white nodules of calcium carbonate. In some places the surface layer is thicker and darker. In other places, the subsoil is thinner and the calcareous substratum is closer to the surface.

Included with these soils in mapping are the severely eroded Lamoni and Shelby soils, which are in areas $\frac{1}{2}$ to 1 acre in size. Lamoni soils are on shoulder slopes, and Shelby soils are in scattered areas on the lower parts of the landscape. Both soils have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Lamoni and Shelby soils. The included soils make up about 5 percent of the unit.

Permeability is slow in the Lamoni soil and moderately slow in the Shelby soil. Runoff is rapid on both soils. The Lamoni soil has a seasonal high water table at a depth of 1 to 3 feet. The available water capacity is high in both soils. The Lamoni soil has a high shrink-swell potential. The content of organic matter is about 2.2 to 3.2 percent in the surface layer of both soils. The soils generally have a very low supply of available phosphorus in the subsoil. The subsoil of the Lamoni soil has a low supply of available potassium, and that of the Shelby soil has a very low supply. Tilth is fair in both soils. The soils tend to puddle if worked when wet.

Most areas are cultivated. Some areas are used as pasture. In most areas these soils are managed along with the adjacent soils. They are poorly suited to corn and small grain. Conservation measures are needed on these soils and on the soils upslope. If cultivated crops are grown, water erosion is a hazard. Row crops should be grown only to establish a pasture. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and contour stripcropping help to prevent excessive soil loss. If terraces are constructed, the cuts should not expose the firm subsoil, which is low in fertility. More intensive management is needed to maintain fertility on these soils than on the less eroded Lamoni and Shelby soils. Deferring tillage during wet periods minimizes

compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soils or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

These soils are suited to grasses for hay. The Lamoni soil is poorly suited to pasture and to legumes for hay because of the seasonal high water table. The Shelby soil is well suited to pasture and is suited to legumes for hay. Growing grasses and legumes for hay and pasture is effective in controlling erosion. Management may be difficult because the Lamoni soil is periodically wet and seepy. Planting forage species that are tolerant of the wetness of the Lamoni soil can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay and grasses for pasture on the Lamoni soil. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soils are wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion.

The land capability classification is IVE.

534—Carlow silty clay, 0 to 2 percent slopes. This nearly level, very poorly drained soil is on bottom land along the major streams. It is occasionally flooded. Areas are irregularly shaped and range from 15 to 20 acres in size.

Typically, the surface layer is black, friable silty clay about 9 inches thick. The subsurface layer is very dark gray, mottled, firm silty clay about 8 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark gray, mottled, firm clay, and the lower part is gray, mottled, firm silty clay. In some places the surface layer is silt loam and has a low content of organic matter. In other places the subsurface layer and subsoil are darker.

Included with this soil in mapping are small areas that are ponded for long periods. These are areas of shallow surface drains. They have few or no adequate outlets. They make up about 5 percent of the unit.

Permeability is very slow in the Carlow soil. Runoff is very slow or ponded. The seasonal high water table is

within a depth of 1 foot. The available water capacity is moderate. The shrink-swell potential is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is very poor. The soil tends to puddle if worked when wet.

Most areas are cultivated. If drained and protected from flooding, this soil is suited to corn, soybeans, and small grain. A tile drainage system generally is not recommended because permeability is very slow and drainage outlets are not readily available. A surface drainage system can effectively remove excess surface water. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and increases the soil temperature. Tilling the silty clay surface layer is difficult. Fall plowing improves the timeliness of fieldwork but increases the susceptibility to soil blowing. Leaving the plowed surface rough and alternating plowed and unplowed strips help to control soil blowing. Chisel plowing, which leaves crop residue on the surface, also helps to control soil blowing. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table and the flooding. Management may be difficult because the soil is poorly drained and occasionally flooded. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands and dikes or levees along the major stream channels may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the extent of ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

A few areas support native hardwoods. This soil is moderately well suited to trees. Because of the very

poor drainage, the use of equipment should be restricted to dry periods or to winter months when the ground is frozen. Machinery equipped with special high flotation tires or tracks can be used for harvesting or management if it is necessary during wet periods. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Erosion is not a limiting factor during logging activities and related road construction.

The land capability classification is IIIw.

534+—Carlow silt loam, overwash, 0 to 2 percent slopes. This nearly level, very poorly drained soil is on bottom land along the major streams. It is occasionally flooded. Areas are irregularly shaped and range from 15 to 100 acres in size.

Typically, the surface layer is stratified dark grayish brown and gray, friable silt loam about 14 inches thick. Below this is a buried surface layer of silty clay about 17 inches thick. The upper part is black and friable, and the lower part is very dark gray, mottled, and firm. The subsoil extends to a depth of about 60 inches or more. The upper part is dark gray, mottled, firm clay, and the lower part is gray, mottled, firm silty clay. In places the dark colors extend to a depth of as much as 3 feet.

Included with this soil in mapping are small areas that are ponded for long periods. These are areas of shallow surface drainage ditches and natural drainageways. They have few or no adequate outlets. They make up about 5 to 10 percent of the unit.

Permeability is very slow in the Carlow soil. Runoff also is very slow. The seasonal high water table is within 1 foot of the surface. The available water capacity is moderate. The shrink-swell potential is high. The content of organic matter is about 1 to 2 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is poor. The soil tends to puddle if worked when wet.

Most areas are cultivated. If drained and protected from flooding, this soil is suited to corn, soybeans, and small grain. A tile drainage system generally is not recommended because permeability is very slow and drainage outlets are not readily available. A surface drainage system can effectively remove the excess surface water. In many areas diverting runoff from the soils upslope and protecting this soil from flooding can improve crop production and minimize siltation. The soil warms up slowly in the spring and dries out slowly after periods of rainfall. In years of heavy rainfall, fieldwork is delayed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to

overcome the wetness and increases the soil temperature. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table and the flooding. Management may be difficult because the soil is poorly drained and occasionally flooded. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands and dikes or levees along the major stream channels may be needed to protect this soil from flooding. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the extent of ponding. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

A few areas support native hardwoods. This soil is moderately well suited to trees. Because of the very poor drainage, the use of equipment should be restricted to dry periods or to winter months when the ground is frozen. Machinery equipped with special high flotation tires or tracks can be used for harvesting or management if it is necessary during wet periods. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Erosion is not a limiting factor during logging activities and related road construction.

The land capability classification is IIIw.

570C—Nira silty clay loam, 5 to 9 percent slopes.

This moderately sloping, moderately well drained soil is on the lower, narrow ridges and short, convex side slopes at the slightly lower elevations in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown, friable silty clay loam about 11 inches thick. The subsoil is mottled silty clay loam about 39 inches thick. The upper part is dark brown and dark yellowish brown and is friable and firm, the next part is grayish brown and light brownish gray and is firm, and the lower part is light brownish gray and firm. The substratum to a depth of about 60 inches is light

brownish gray, mottled silty clay loam. In places the upper part of the subsoil is dark grayish brown. In some areas the surface layer is thinner because of erosion.

Included with this soil in mapping are areas of the poorly drained Clarinda and somewhat poorly drained Lamoni soils. These soils are on the lower side slopes and narrow, convex interfluves. They contain more clay in the subsoil than the Nira soil and are low in natural fertility. They make up about 5 to 10 percent of the unit.

Permeability is moderate in the Nira soil. Runoff is medium. The available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. Some areas are used for hay or pasture. This soil is moderately well suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface (fig. 11), contour farming, contour stripcropping, crop rotations that include meadow crops, and terraces help to prevent excessive soil loss. If rainfall is above normal, the soil becomes seasonally wet on the lower slopes and near drainageways. A combination of tile drainage and terraces is needed to improve the timeliness of fieldwork and to control erosion. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is well suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to



Figure 11.—No-till soybeans in an area of Nira silty clay loam, 5 to 9 percent slopes.

control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

570C2—Nira silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on narrow ridges and short, convex side slopes at the slightly lower elevations in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 40 acres in size.

Typically, the surface layer is very dark grayish

brown, friable silty clay loam about 6 inches thick. Plowing has mixed some of the dark brown and dark yellowish brown subsoil with the surface layer. The subsoil is mottled silty clay loam about 38 inches thick. The upper part is dark brown and dark yellowish brown and is friable and firm, the next part is grayish brown and light brownish gray and is firm, and the lower part is light brownish gray and is firm. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam. In places the upper part of the subsoil is dark grayish brown.

Included with this soil in mapping are areas of the poorly drained Clarinda and somewhat poorly drained Lamoni soils. These soils are on the lower side slopes and narrow, convex interfluvies. They contain more clay in the subsoil than the Nira soil and are low in natural fertility. They make up about 5 to 10 percent of the unit.

Permeability is moderate in the Nira soil. Runoff is medium. The available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. Some areas are used for hay or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, contour stripcropping, crop rotations that include meadow crops, and terraces help to prevent excessive soil loss. If rainfall is above normal, the soil may become seasonally wet on the lower slopes and near drainageways. A combination of tile drainage and terraces is needed to improve the timeliness of fieldwork and to control erosion. More intensive management is needed to maintain fertility on this soil than on the less eroded Nira soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is well suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to

control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

570D—Nira silty clay loam, 9 to 14 percent slopes.

This strongly sloping, moderately well drained soil is on convex side slopes in the uplands. Areas typically are long and narrow and range from 5 to 40 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is mottled silty clay loam about 37 inches thick. The upper part is brown and firm, the next part is grayish brown and light brownish gray and is firm, and the lower part is light brownish gray and friable. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam. In places the upper part of the subsoil is dark grayish brown. In some areas the surface layer is thinner because of erosion.

Included with this soil in mapping are small areas of the somewhat poorly drained Lamoni soils on the lower slopes. These soils have layers of clay in the subsoil. They make up less than 5 percent of the unit.

Permeability is moderate in the Nira soil. Runoff is rapid. The available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are cultivated. Some areas are used for hay or pasture. This soil is suited to corn, soybeans, and small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, erosion is a hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, crop rotations that include meadow crops, contour stripcropping, and terraces help to prevent excessive soil loss. Because the soil tends to be wet and seepy near drainageways and on the lower slopes, a combination of tile drainage and terraces is needed to improve the timeliness of fieldwork and to control erosion. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is well suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain

productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

570D2—Nira silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes in the uplands. Areas typically are long and narrow and range from 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 6 inches thick. Plowing has mixed some of the brown subsoil with the surface layer. The subsoil is mottled silty clay loam about 36 inches thick. The upper part is brown and friable, the next part is grayish brown and light brownish gray and is firm, and the lower part is light brownish gray and friable. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam. In places the upper part of the subsoil is dark grayish brown.

Included with this soil in mapping are small areas of the somewhat poorly drained Lamoni soils on the lower slopes. These soils have layers of clay in the subsoil. They make up about 5 to 10 percent of the unit.

Permeability is moderate in the Nira soil. Runoff is rapid. The available water capacity is high. The seasonal high water table is at a depth of 4 to 6 feet. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium. Tillage is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. Some areas are used for hay or pasture. This soil is suited to corn, soybeans, and small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, water erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, crop rotations that include meadow crops, contour stripcropping, and terraces help

to prevent excessive soil loss. Because the soil tends to be wet and seepy near drainageways and on the lower slopes during the spring, a combination of tile drainage and terraces is needed to improve the timeliness of fieldwork and to control erosion. More intensive management is needed to maintain fertility on this soil than on the less eroded Nira soils. Deferring tillage during wet periods minimizes compaction and improves tillage. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is well suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and in the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

592C—Mystic loam, 5 to 9 percent slopes. This moderately sloping, somewhat poorly drained soil is on narrow ridges and the short, convex to slightly concave side slopes of high stream benches and on some concave foot slopes in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 10 acres in size.

Typically, the surface layer is very dark gray, friable loam about 9 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is brown and strong brown, mottled, firm clay; the next part is mottled strong brown, dark yellowish brown, grayish brown, light gray, and yellowish red, firm clay loam; and the lower part is mottled strong brown, yellowish red, light brownish gray, and light gray, friable sandy clay loam and clay loam. In

some areas the soil contains more silt and less sand. In other areas the surface layer is thinner because of erosion.

Included with this soil in mapping are small areas of the moderately well drained Caleb soils. These soils are on the lower side slopes. They make up 5 to 10 percent of the unit.

Permeability is slow in the Mystic soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture, hayland, or woodland. This soil generally is poorly suited to corn and soybeans. It is better suited to small grain. Because it is mainly in small areas, it generally is managed along with the adjacent soils, which are better suited to row crops. If cultivated crops are grown, water erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes help to prevent excessive soil loss. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a

seedbed, and interseeding on the contour help to control erosion.

A few areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

592C2—Mystic clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained soil is on narrow ridges and the short, convex to slightly concave side slopes of high stream benches and on some concave foot slopes in the uplands. Areas are long and narrow or irregularly shaped and range from 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some of the brown and strong brown clay from the subsoil with the surface layer. The subsoil is about 46 inches thick. The upper part is mottled brown, strong brown, dark yellowish brown, and grayish brown, firm clay; the next part is mottled strong brown, dark yellowish brown, grayish brown, light gray, and yellowish red loam; and the lower part is mottled strong brown, yellowish red, light brownish gray, and light gray, friable sandy clay loam and clay loam. The substratum to a depth of about 60 inches is strong brown, mottled clay loam. In some areas the soil contains more silt and less sand. In other areas the surface layer is thinner because of severe erosion.

Included with this soil in mapping are small areas of the moderately well drained Caleb soils. These soils are on the lower side slopes. They make up 5 to 10 percent of the unit.

Permeability is slow in the Mystic soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

This soil is used mainly for pasture, hay, or row crops. It is suited to corn, soybeans, and small grain. Because it is in relatively small areas, it generally is managed along with the adjacent soils, which are better suited to row crops. If cultivated crops are grown, water erosion is a severe hazard. Conservation measures are needed on this soil and on the adjacent soils. A system of conservation tillage that leaves crop residue on the

surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes help to prevent excessive soil loss. More intensive management is needed to maintain fertility on this soil than on the less eroded Mystic soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IIIe.

592D—Mystic loam, 9 to 14 percent slopes. This strongly sloping, somewhat poorly drained soil is on the short, convex or slightly concave side slopes of the escarpments on high stream benches and on some concave foot slopes in the uplands. These are dominantly south- and east-facing slopes. Areas are long and narrow or irregularly shaped and range from 4 to 20 acres in size.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 3 inches thick. The subsoil is about 45 inches thick. The upper part is mottled brown, strong brown, dark yellowish brown, and grayish brown, firm clay; the next part is mottled strong brown, dark yellowish brown, grayish brown, light gray, and yellowish red, firm clay loam; and the lower part is

mottled strong brown, yellowish red, light brownish gray, and light gray, friable sandy clay loam and clay loam. The substratum to a depth of about 60 inches is strong brown, mottled clay loam. In some areas the soil contains more silt and less sand. In areas dominated by prairie grasses, the subsurface layer is thicker and darker. In places the surface layer is thinner because of erosion.

Included with this soil in mapping are small areas of the moderately well drained Caleb and well drained Gara soils. Caleb soils are on the lower side slopes. Gara soils are on side slopes or are upslope from the Mystic soil. The included soils make up about 5 to 15 percent of the unit.

Permeability is slow in the Mystic soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used as pasture, hayland, or woodland. This soil generally is poorly suited to corn, soybeans, and small grain. Because it is mainly in small areas, it generally is managed along with the adjacent soils, which are better suited to row crops. If cultivated crops are grown, water erosion is a very severe hazard. Conservation measures are needed on this soil and on the adjacent soils. Contour farming, grassed waterways, crop rotations that include grasses and legumes, and a system of conservation tillage that leaves crop residue on the surface help to control erosion. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Growing grasses and legumes for hay and pasture is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates,

pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

A few areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

592D2—Mystic clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on the short, convex or slightly concave side slopes of the escarpments on high stream benches and on some foot slopes in the uplands. These are dominantly south- and east-facing slopes. Areas are long and narrow or irregularly shaped and range from 4 to 20 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some of the brown and strong brown clay from the subsoil with the surface layer. The subsoil is about 47 inches thick. The upper part is mottled brown, strong brown, dark yellowish brown, and grayish brown, firm clay; the next part is mottled strong brown, dark yellowish brown, grayish brown, light gray, and yellowish red, firm and friable clay loam; and the lower part is mottled strong brown, yellowish red, light brownish gray, light gray, and grayish brown, friable sandy clay loam and clay loam. The substratum to a depth of about 60 inches is strong brown, mottled clay loam. In some areas the soil contains more silt and less sand. In areas dominated by prairie grasses, the surface layer is darker. In places the surface layer is thinner because of severe erosion.

Included with this soil in mapping are small areas of the moderately well drained Caleb and well drained Gara soils. Caleb soils are on the lower side slopes. Gara soils are on side slopes or are upslope from the Mystic soil. The included soils make up about 5 to 15 percent of the unit.

Permeability is slow in the Mystic soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if

worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used for pasture, hay, or row crops. This soil generally is poorly suited to corn, soybeans, and small grain. Because it is mainly in small areas, it generally is managed along with the adjacent soils, which are better suited to row crops. If row crops are grown, water erosion is a very severe hazard. Conservation measures are needed on this soil and on the adjacent soils. Contour farming, grassed waterways, crop rotations that include grasses and legumes, and a system of conservation tillage that leaves crop residue on the surface help to control erosion. More intensive management is needed to maintain fertility on this soil than on the less eroded Mystic soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Growing grasses and legumes for hay and pasture is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely.

Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

592E2—Mystic clay loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, somewhat poorly drained soil is on short, convex to concave side slopes in the uplands that border large drainageways and on the short, convex or slightly concave side slopes

of escarpments on high stream benches. These are dominantly south- and east-facing slopes. Areas are long and narrow or irregularly shaped and range from 4 to 10 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 5 inches thick. Plowing has mixed some of the brown and strong brown clay from the subsoil with the surface layer. The subsoil is about 40 inches thick. The upper part is mottled brown, strong brown, dark yellowish brown, and grayish brown, firm clay; the next part is mottled strong brown, dark yellowish brown, grayish brown, light gray, and yellowish red, firm clay loam; and the lower part is mottled strong brown, yellowish red, light brownish gray, and light gray, friable sandy clay loam. The substratum to a depth of about 60 inches is strong brown, mottled clay loam. In some areas the soil contains more silt and less sand. In areas dominated by prairie grasses, the surface layer is darker.

Included with this soil in mapping are small areas of the moderately well drained Caleb and well drained Gara soils. Caleb soils are on the lower side slopes. Gara soils are on side slopes or are upslope from the Mystic soil. Also included are the severely eroded Mystic soils, which generally are in areas about ½ acre in size. These soils have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Mystic soils. The included soils make up about 5 to 15 percent of the unit.

Permeability is slow in the Mystic soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are used for hay or pasture. Some areas are cultivated, and most were cultivated in the past. This soil generally is unsuited to row crops and small grain. It is poorly suited to grasses for hay and pasture. It is poorly suited to legumes because of the seasonal high water table. Growing grasses and legumes for hay and pasture is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is too wet causes surface compaction,

which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

This soil is suited to trees. Carefully locating logging trails or roads and laying out the trails and roads on the contour or nearly on the contour reduce the hazard of erosion. Because of the slope, operating equipment is somewhat hazardous. Special equipment can be used. Caution is needed in operating the equipment. Seedlings survive and grow well.

The land capability classification is Vle.

792C—Armstrong loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on the lower, narrow ridges and short, convex side slopes in the uplands. Areas are long and narrow or irregularly shaped and range from 3 to 25 acres in size.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil to a depth of about 60 inches is clay loam. The upper part is mottled yellowish brown, dark grayish brown, and yellowish red and is friable; the next part is mottled yellowish brown, grayish brown, and red and is firm; and the lower part is mottled strong brown, grayish brown, and light brownish gray and is firm. In some places the surface layer is thinner because of erosion. In other places the subsoil is grayer.

Permeability is slow. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are used as pasture or woodland. This soil is suited to corn and soybeans. It is better suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces

are constructed, the cuts should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IIIe.

792C2—Armstrong clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on the lower, narrow ridges and short, convex side slopes in the uplands. Areas are long and narrow or irregularly shaped and range from 3 to 25 acres in size.

Typically, the surface layer is very dark grayish brown and dark gray, friable clay loam about 8 inches thick. Plowing has mixed some of the dark yellowish brown subsoil with the surface layer. The subsoil to a depth of about 60 inches is clay loam. The upper part is dark yellowish brown and friable; the next part is mottled yellowish brown, dark grayish brown, grayish brown, and red and is firm; and the lower part is mottled

strong brown, grayish brown, and light brownish gray and is firm. In some areas the subsoil is grayer.

Included with this soil in mapping are the severely eroded Armstrong soils, which generally are in scattered areas about ¼ to ½ acre in size. These soils have a low content of organic matter and have clay mixed in the plow layer. More intensive management is needed to maintain fertility on these soils than on the less eroded Armstrong soils. The included soils make up 5 to 10 percent of the unit.

Permeability is slow in the Armstrong soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 2 to 3 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are cultivated. This soil is suited to corn and soybeans. It is better suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, water erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. More intensive management is needed to maintain fertility on this soil than on the less eroded Armstrong soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of

grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures and preparing a seedbed on the contour help to control erosion.

Most of the trees on this soil are in groves and around farmsteads. The soil is suited to woodland. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IIIe.

792D—Armstrong loam, 9 to 14 percent slopes.

This strongly sloping, moderately well drained soil is on short, convex side slopes, on shoulder slopes, and on the lower, narrow ridges in the uplands. Areas are irregularly shaped or long and narrow and range from 3 to 25 acres in size.

Typically, the surface layer is very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil is clay loam about 45 inches thick. The upper part is mottled yellowish brown, dark grayish brown, and yellowish red and is friable; the next part is mottled yellowish brown, grayish brown, and red and is firm; and the lower part is mottled strong brown, grayish brown, and light brownish gray and is firm. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown clay loam. In some places the surface layer is thinner because of erosion. In other places the subsoil is grayer.

Permeability is slow. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are used as pasture or woodland. This soil generally is poorly suited to intensive row cropping but is suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include

grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IVe.

792D2—Armstrong clay loam, 9 to 14 percent slopes, moderately eroded.

This strongly sloping, moderately well drained soil is on short, convex side slopes, on shoulder slopes, and on the lower, narrow ridges in the uplands. Areas are irregularly shaped or long and narrow and range from 3 to 25 acres in size.

Typically, the surface layer is very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some of the dark yellowish brown subsoil with the surface layer. The subsoil is clay loam about 43 inches thick. The upper part is dark yellowish brown and mottled yellowish brown, dark grayish brown, and

yellowish red and is friable; the next part is mottled yellowish brown, grayish brown, and red and is firm; and the lower part is mottled strong brown, grayish brown, and light brownish gray and is firm. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown clay loam. In some areas the subsoil is grayer.

Included with this soil in mapping are the severely eroded Armstrong soils, which generally are in scattered areas about $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. These soils have a low content of organic matter and have clay mixed in the plow layer. More intensive management is needed to maintain fertility on these soils than on the less eroded Armstrong soils. The included soils make up 5 to 10 percent of the unit.

Permeability is slow in the Armstrong soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil typically has a very low supply of available phosphorus and potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are cultivated. This soil generally is poorly suited to intensive row cropping but is suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, water erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. More intensive management is needed to maintain fertility on this soil than on the less eroded Armstrong soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Maintaining a cover of hay or pasture plants is effective in controlling erosion. The soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of

legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IVe.

822C—Lamoni silty clay loam, 5 to 9 percent slopes. This moderately sloping, somewhat poorly drained soil is on short, convex side slopes, which are near the upper ends of drainageways, and on the lower, narrow ridges in the uplands that border major drainage divides. Areas are irregularly shaped and range from 4 to 25 acres in size.

Typically, the surface layer is black, friable silty clay loam about 11 inches thick. The subsoil extends to a depth of about 60 inches. It is firm. The upper part is dark grayish brown and grayish brown, mottled clay; the next part is light gray, mottled clay; and the lower part is mottled yellowish brown, light gray, and strong brown clay loam. In places subsoil is clay throughout.

Included with this soil in mapping are small areas of the well drained Shelby soils. These soils are on the lower side slopes. They contain less clay in the subsoil than the Lamoni soil. They make up about 5 to 15 percent of the unit.

Permeability is slow in the Lamoni soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are used as pasture. This soil is suited to corn and soybeans. It is better suited to small grain. Conservation measures are needed on this soil and on

the soils upslope. If row crops are grown, water erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Growing grasses and legumes for hay and pasture is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

The land capability classification is IIIe.

822C2—Lamoni silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained soil is on short, convex side slopes, which are near the upper ends of drainageways, and on the lower, narrow ridges in the uplands that border major drainage divides. Areas are irregularly shaped and range from 4 to 25 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. Plowing has mixed some of the dark grayish brown subsoil with the surface layer. The subsoil extends to a depth of about 60 inches. It is firm. The upper part is dark grayish brown and grayish brown, mottled clay; the next part is light

gray, mottled clay; and the lower part is mottled light gray and yellowish brown clay loam. In places the subsoil is clay throughout.

Included with this soil in mapping are small areas of the well drained Shelby soils. These soils are on the lower side slopes. They contain less clay in the subsoil than the Lamoni soil. Also included are the severely eroded Lamoni soils, which generally are in scattered areas about ¼ to ½ acre in size. These soils have a low content of organic matter and have a surface layer of clay. More intensive management is needed on these soils to maintain fertility than on the less eroded Lamoni soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Lamoni soil. Runoff is medium. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is suited to corn and soybeans. It is better suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, water erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. More intensive management is needed to maintain fertility on this soil than on the less eroded Lamoni soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Growing grasses and legumes for hay and pasture is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay. Conservation measures may be needed to improve

the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

The land capability classification is IIIe.

822D—Lamoni silty clay loam, 9 to 14 percent slopes. This strongly sloping, somewhat poorly drained soil is on short, convex side slopes, which are near the upper ends of upland drainageways, and at the lower elevations along the major drainage divides. Areas are irregularly shaped and range from 4 to 25 acres in size.

Typically, the surface layer is black, friable silty clay loam about 10 inches thick. The subsoil extends to a depth of about 60 inches. It is firm. The upper part is grayish brown and dark grayish brown, mottled clay; the next part is mottled light gray clay; and the lower part is mottled light gray, yellowish brown, and strong brown clay loam.

Included with this soil in mapping are small areas of the well drained Shelby soils. These soils are on the lower side slopes. They contain less clay in the subsoil than the Lamoni soil. They make up about 5 to 10 percent of the unit.

Permeability is slow in the Lamoni soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is good, but the soil tends to puddle if worked when wet.

Most areas are used as pasture. This soil is poorly suited to intensive row cropping but is suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, water erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more

difficult even if the terrace channel is topdressed with surface soil material. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Growing grasses and legumes for hay and pasture is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

The land capability classification is IVe.

822D2—Lamoni silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on short, convex side slopes, which are near the upper ends of drainageways in the uplands, and at the lower elevations along the major drainage divides. Areas are irregularly shaped and range from 4 to 30 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 5 inches thick. Plowing has mixed some of the dark grayish brown subsoil with the surface layer. The subsoil extends to a depth of about 60 inches. It is firm. The upper part is grayish brown and dark grayish brown, mottled clay; the next part is light gray, mottled clay; and the lower part is mottled light gray and yellowish brown clay loam.

Included with this soil in mapping are small areas of the well drained Shelby soils. These soils are on the lower side slopes. They contain less clay in the subsoil than the Lamoni soil. Also included are the severely eroded Lamoni soils, which generally are in scattered areas about ¼ to ½ acre in size. These soils have a low content of organic matter and have a surface layer

of clay. More intensive management is needed to maintain fertility on these soils than on the less eroded Lamoni soils. The included soils make up about 5 to 15 percent of the unit.

Permeability is slow in the Lamoni soil. Runoff is rapid. The seasonal high water table is at a depth of 1 to 3 feet. The available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is poorly suited to intensive row cropping but is suited to small grain. Conservation measures are needed on this soil and on the soils upslope. If row crops are grown, water erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and crop rotations that include grasses and legumes. If terraces are needed, they generally should be constructed on the adjacent soils upslope. Terrace cuts on this soil should not expose the clayey subsoil. If the subsoil is exposed, preparing a seedbed is more difficult even if the terrace channel is topdressed with surface soil material. More intensive management is needed to maintain fertility on this soil than on the less eroded Lamoni soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is suited to grasses for hay but is poorly suited to pasture. It is poorly suited to legumes because of the seasonal high water table. Growing grasses and legumes for hay and pasture is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in the adjacent soils above the seep line can improve the growth of legume crops for hay. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a

seedbed, and interseeding on the contour help to control erosion.

The land capability classification is IVe.

831C2—Pershing silty clay loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained or somewhat poorly drained soil is on ridges and side slopes on loess-covered stream benches. Areas typically are long and narrow and range from 4 to 15 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 5 inches thick. Plowing has mixed some of the brown subsoil with the surface layer. The subsoil extends to a depth of about 60 inches. The upper part is brown, firm silty clay loam; the next part is grayish brown, mottled, firm silty clay; and the lower part is light brownish gray, mottled, friable silty clay loam.

Included with this soil in mapping are scattered small areas of Caleb and Mystic soils. These soils contain more sand than the Pershing soil. Also, they are lower on the landscape. Also included are the severely eroded Pershing soils, which generally are in scattered areas about ¼ to ½ acre in size. These soils have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Pershing soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Pershing soil. Runoff is medium. The available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet. The shrink-swell potential is high. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain. Because it is mainly in small areas, it generally is farmed along with the adjacent soils, which are better suited to row crops. Conservation measures are needed on this soil and on the soils upslope. If cultivated crops are grown, water erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, contour stripcropping, grassed waterways, and crop rotations that include grasses and legumes. Because slopes are short and irregular, constructing terraces may be difficult. Terrace cuts should not expose the clayey subsoil. If the subsoil is exposed, working the soil is

difficult and the terrace channels may become seepy. A combination of tile drainage and terraces can help to control erosion and improve the timeliness of fieldwork in years when rainfall is above normal. Grassed waterways help to prevent gully erosion. More intensive management is needed to maintain fertility on this soil than on the less eroded Pershing soils. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses for hay and is suited to pasture. It is suited to legumes if an adequate drainage system is installed. Growing grasses and legumes is effective in controlling erosion. Management may be difficult, however, because the soil is periodically wet and seepy. Planting forage species that are tolerant of wetness can help to maintain productivity. Properly located drainage tile in this soil and the adjacent soils upslope can improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

This soil is suited to trees. Natural and planted seedlings do not survive well. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IIIe.

870B—Sharpsburg silty clay loam, benches, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on ridges and short, convex side slopes on broad, loess-covered stream benches. Areas are long and irregularly shaped and range from 5 to 25 acres in size.

Typically, the surface layer is black and very dark brown, friable silty clay loam about 8 inches thick. The subsurface layer is dark brown and very dark grayish

brown, friable silty clay loam about 9 inches thick. The subsoil is friable silty clay loam about 36 inches thick. The upper part is brown, and the lower part is brown and grayish brown and is mottled. The substratum to a depth of about 60 inches is mottled grayish brown and light brownish gray silty clay loam. Stratified, loamy alluvium is at a depth of 10 to 12 feet. In places the surface soil is very dark grayish brown and grayish brown.

Permeability is moderately slow. Runoff is slow. The seasonal high water table is at a depth of 4 to 6 feet. The available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low to high supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, terraces, crop rotations that include grasses and legumes, and contour stripcropping or by a combination of these measures. Grassed waterways help to prevent gully erosion. Deferring tillage during wet periods minimizes compaction and improves tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is well suited to grasses and legumes for hay and pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIe.

870C2—Sharpsburg silty clay loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on narrow ridges and short, convex side slopes on loess-covered stream benches. Areas are narrow and irregularly shaped and range from 5 to 15 acres in size.

Typically, the surface layer is very dark grayish

brown, friable silty clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of brown silty clay loam from the subsoil with the surface layer. The subsoil is friable silty clay loam about 33 inches thick. The upper part is brown, and the lower part is brown and grayish brown and is mottled. The substratum to a depth of about 60 inches is mottled grayish brown and light brownish gray silty clay loam. Stratified, loamy alluvium is at a depth of 8 to 10 feet. In places the plow layer is mixed very dark grayish brown and grayish brown.

Included with this soil in mapping are scattered small areas of Caleb and Mystic soils. These soils contain more sand than the Sharpsburg soil. Also, they are lower on the landscape. Also included are the severely eroded Sharpsburg soils, which generally are in scattered areas about $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. These soils have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Sharpsburg soils. The included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Sharpsburg soil. Runoff is medium. The seasonal high water table is at a depth of 4 to 6 feet. The available water capacity is high. The content of organic matter is about 2.7 to 3.7 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain. If cultivated crops are grown, water erosion is a hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, terraces, crop rotations that include grasses and legumes, and contour stripcropping or by a combination of these measures. Deferring tillage during wet periods minimizes compaction and improves tilth. More intensive management is needed to maintain fertility on this soil than on the less eroded Sharpsburg soils. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth, helps to control erosion, and increases the rate of water infiltration. Lime generally is needed if it has not been applied in the past 3 to 5 years.

This soil is moderately well suited to grasses and legumes for hay and is well suited to pasture. Overgrazing or grazing when the soil is too wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, and deferment of grazing during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting,

measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion. Terraces and diversions may be needed to protect critical areas.

The land capability classification is IIIe.

993D—Gara-Armstrong loams, 9 to 14 percent slopes. These strongly sloping soils are in the uplands. The well drained Gara soil is on the lower, convex side slopes, and the moderately well drained Armstrong soil is on the upper, convex shoulder slopes. Areas are irregularly shaped and range from 5 to 15 acres in size. They are about 60 percent Gara soil and 40 percent Armstrong soil. The two soils occur as areas so small that mapping them separately is impractical.

Typically, the Gara soil has a surface layer of very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 5 inches thick. The subsoil is clay loam about 33 inches thick. The upper part is dark grayish brown and friable, and the lower part is yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches is mottled yellowish brown and strong brown, calcareous clay loam. It has white nodules of lime. In some places the surface layer is thicker and darker. In other places it is thinner because of erosion. In some areas, the subsoil is thinner and the calcareous substratum is closer to the surface.

Typically, the Armstrong soil has a surface layer of very dark gray, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil is clay loam about 45 inches thick. The upper part is mottled yellowish brown, dark grayish brown, and yellowish red and is friable; the next part is mottled yellowish brown, grayish brown, and red and is friable; and the lower part is mottled strong brown, grayish brown, and light brownish gray and is firm. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown clay loam. In some places the surface layer is thinner because of erosion. In other places the subsoil is grayer.

Permeability is moderately slow in the Gara soil and slow in the Armstrong soil. Runoff is rapid on both soils. The Armstrong soil has a seasonal high water table at a depth of 1 to 3 feet. The available water capacity is high in both soils. The Armstrong soil has a high shrink-swell potential. The content of organic matter is about 2.5 to 3.5 percent in the surface layer of both soils. The subsoil of the Gara soil generally has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Armstrong soil generally



Figure 12.—A pasture that supports scattered trees in an area of Gara-Armstrong loams, 9 to 14 percent slopes.

has a very low supply of available phosphorus and potassium. Tilth is good in the Gara soil and fair in the Armstrong soil. The soils tend to puddle if worked when wet. The Gara soil tends to crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are cultivated. Some of the large areas are used as pasture (fig. 12). In most areas these soils are managed along with the adjacent soils. They are poorly suited to corn and soybeans. They are better suited to small grain. Conservation measures are needed on these soils and on the soils upslope. If cultivated crops are grown, erosion is a hazard. Row crops should be grown only to establish a pasture. A system of conservation tillage that leaves crop residue on the surface and contour stripcropping help to prevent excessive soil loss. If terraces are constructed, the cuts

should not expose the firm subsoil, which is low in fertility. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soils or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 5 years.

These soils are suited to grasses for hay. The Gara soil is well suited to pasture and is suited to legumes for hay, but the Armstrong soil is poorly suited because of the seasonal high water table. Growing grasses and legumes for hay and pasture is effective in controlling erosion. The Armstrong soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or

timely. Conservation measures may be needed on these soils to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soils are wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

Many small areas support native hardwoods. These soils are suited to trees. Natural and planted seedlings do not survive well on the Armstrong soil. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard on the Armstrong soil. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IVe.

993D2—Gara-Armstrong complex, 9 to 14 percent slopes, moderately eroded. These strongly sloping soils are in the uplands. The well drained Gara soil is on the lower, convex side slopes, and the moderately well drained Armstrong soil is on the upper, convex shoulder slopes. Areas are irregularly shaped and range from 5 to 15 acres in size. They are about 55 percent Gara soil and 40 percent Armstrong soil. The two soils occur as areas so small that mapping them separately is impractical.

Typically, the Gara soil has a surface layer of very dark grayish brown, friable loam about 6 inches thick. Plowing has mixed some of the dark grayish brown subsoil with the surface layer. The subsoil is about 31 inches thick. The upper part is dark grayish brown, friable clay loam, and the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 60 inches is mottled yellowish brown and strong brown, calcareous clay loam. It has nodules of lime. In some places the surface layer is thicker and darker. In other places, the subsoil is thinner and the calcareous substratum is closer to the surface.

Typically, the Armstrong soil has a surface layer of very dark grayish brown, friable clay loam about 6 inches thick. Plowing has mixed some of the dark yellowish brown subsoil with the surface layer. The subsoil is clay loam about 43 inches thick. The upper part is dark yellowish brown and friable; the next part is

mottled yellowish brown, grayish brown, and red and is firm; and the lower part is mottled strong brown and grayish brown and is firm. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown clay loam. In some areas the subsoil is grayer.

Included with these soils in mapping are the severely eroded Armstrong and Gara soils, which generally are in areas ½ to 1 acre in size. Armstrong soils are on shoulder slopes, and Gara soils are in scattered areas on the lower parts of the landscape. Both soils have a low content of organic matter. More intensive management is needed to maintain fertility on these soils than on the less eroded Gara and Armstrong soils. The included soils make up about 5 percent of the unit.

Permeability is moderately slow in the Gara soil and slow in the Armstrong soil. Runoff is rapid on both soils. The Armstrong soil has a seasonal high water table at a depth of 1 to 3 feet. The available water capacity is high in both soils. The shrink-swell potential is high in the Armstrong soil. The content of organic matter is about 2 to 3 percent in the surface layer of both soils. The subsoil of the Gara soil generally has a low supply of available phosphorus and a very low supply of available potassium. The subsoil of the Armstrong soil generally has a very low supply of available phosphorus and potassium. Tilth is fair in both soils. The soils tend to puddle if worked when wet and crust after hard rains. The crusting can retard seedling emergence and development.

Most areas are cultivated. Some of the large areas are used as pasture. In most areas these soils are managed along with the adjacent soils. They are poorly suited to corn and soybeans. They are better suited to small grain. Conservation measures are needed on these soils and on the soils upslope. If cultivated crops are grown, water erosion is a hazard. Row crops should be grown only to establish a pasture. A system of conservation tillage that leaves crop residue on the surface and contour strip cropping help to prevent excessive soil loss. If terraces are constructed, the cuts should not expose the firm subsoil, which is low in fertility. More intensive management is needed to maintain fertility on these soils than on the less eroded Gara and Armstrong soils. Deferring tillage during wet periods minimizes compaction and improves tilth. In places concentrations of medium to large stones and rocks are on the surface. These can interfere with some tillage and harvesting activities. Returning crop residue to the soils or regularly adding other organic material improves fertility and minimizes crusting. Lime generally is needed if it has not been applied in the past 3 to 5 years.

These soils are suited to grasses for hay. The Gara soil is well suited to pasture and is suited to legumes

for hay, but the Armstrong soil is poorly suited because of the seasonal high water table. Growing grasses and legumes for hay and pasture is effective in controlling erosion. The Armstrong soil may become droughty in the latter part of the growing season, and forage production can be reduced if rainfall is not adequate or timely. Conservation measures may be needed to improve the growth of legume crops for hay and grasses for pasture. Overgrazing or grazing when the soils are wet causes surface compaction, which restricts root development and increases the runoff rate. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted equipment use during wet periods help to keep the pasture in good condition. Measures that maintain fertility, weed and brush control, and timely applications of lime improve the productivity of the pasture or hayland. When the pasture or hayland is renovated, applying cultural measures, preparing a seedbed, and interseeding on the contour help to control erosion.

Many small areas support native hardwoods. These soils are suited to trees. Natural and planted seedlings do not survive well on the Armstrong soil. A large number of seedlings can be planted at close intervals. Once the stand is established, thinning the surviving trees can achieve a desirable stand density. Harvest methods that do not leave the remaining trees widely spaced reduce the windthrow hazard on the Armstrong soil. No other major hazards or limitations affect planting or harvesting.

The land capability classification is IVe.

1220—Nodaway silt loam, channeled, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on bottom land along the major streams. It is frequently flooded. The landscape is dissected by many deep, old stream meanders. Areas are elongated and range from 50 to 200 acres in size.

Typically, the surface layer is very dark gray and dark grayish brown, friable silt loam about 7 inches thick. The substratum to a depth of about 60 inches is stratified very dark gray, dark grayish brown, and grayish brown, friable silt loam. In some areas the surface layer is loam or sandy loam.

Included with this soil in mapping are small areas of sandy soils on sandbars and benches along stream channels. These soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Nodaway soil. Runoff is slow. The seasonal high water table is at a depth of 3 to 5 feet. The available water capacity is very high. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of

available potassium. Tilth is fair. The soil tends to puddle if worked when wet.

Most areas are used as woodland or permanent pasture. Most of the areas used as permanent pasture support scattered trees and brush. A few small areas between old channels are cultivated in some years. Because of the flooding and the numerous old stream channels and oxbows, this soil generally is unsuited to cultivated crops and hay. If protected from flooding, it is suited to pasture and woodland. Cropping this soil is difficult even if trees are removed, channels are straightened and filled, levees or dikes are built, and drainage ditches are installed. Fertilizer requirements and weed control are of greater concern in areas that are cleared and renovated than in other areas.

This soil is poorly suited to grasses for hay. It is poorly suited to pasture because of the flooding and to legumes because of the seasonal high water table and the flooding. Management may be difficult because the soil is frequently flooded. Planting forage species that are tolerant of wetness can help to maintain productivity. A drainage system is necessary if alfalfa is grown. Diversions or terraces on the adjacent soils in the uplands and dikes or levees along the major stream channels may be needed to protect this soil from flooding. Overgrazing or grazing during wet periods causes surface compaction and puddling. Pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. Selection of suitable forage species for planting, measures that maintain fertility, weed control, and timely applications of lime improve the productivity of the pasture or hayland.

Many small areas support native hardwoods. This soil is suited to trees if flooding is controlled. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is managed properly.

The land capability classification is Vw.

5010—Pits, sand and gravel. These are open pits from which sand and gravel have been removed. They are 15 to 30 feet deep. Most of the pits formerly were mined but are now abandoned. Some areas are covered with spoil material. Areas are irregularly shaped and range from 20 to 40 acres in size.

Permeability varies but generally is moderately rapid to very rapid. Reaction typically ranges from strongly acid to neutral.

Water accumulates in some of the pits. Many inactive pits provide habitat for fish.

This map unit has not been assigned a land capability classification.

5030—Pits, limestone quarries. These are pits from which limestone has been quarried, mainly for use in road construction and for agricultural lime. The pits are 30 to more than 40 feet deep and are surrounded by piles of spoil 15 or more feet high. Some have steep sides and contain water, which is a few feet to many feet deep. Areas are irregularly shaped and are a few acres in size.

The soil surrounding the pits varies in texture but generally is loamy. It has varying amounts of limestone fragments. It is derived from glacial till, eolian material, loess, or a mixture of these. In some areas it has been leveled and smoothed, but in other areas it is very uneven. In the level areas grasses or trees grow reasonably well. The spoil ranges from medium acid to mildly alkaline.

The quarries are well suited to wildlife habitat. Those containing water can support fish. They could be dangerous as sites for recreation and as habitat for wildlife, however, because of the steep sides and the variable depth of the water. Onsite investigation is needed to determine the hazard.

This map unit has not been assigned a land capability classification.

5040—Orthents, loamy. These nearly level to strongly sloping soils are mainly in borrow areas, where soil material is removed for use in construction. Many areas near small towns are used as building sites. In some areas the original soil has been removed to a depth of 5 to more than 20 feet. In other areas 4 to 10 inches of topsoil has been redistributed, generally in an uneven pattern. The soils range from excessively drained to somewhat poorly drained, depending on the kind of material from which the soils were derived and the extent to which the borrow area is restored. Areas typically range from 6 to 50 acres in size.

Typically, the upper 60 inches is yellowish brown, friable and firm loam. In many areas cobbles and pebbles are on the surface. In places the texture is sandy loam. The surface layer is very dark gray to dark brown.

Included with these soils in mapping are small areas of sand. Also included are a few areas that were once dumps or landfills, which have been covered.

Permeability varies in the Orthents, depending on the texture and density of the soil material. Runoff is slow to rapid. The available water capacity is moderate or low. Soil that was once buried 5 to 20 feet or more beneath the surface has less pore space and a higher density than the original surface layer. It has not been appreciably affected by the processes of soil formation, such as freezing and thawing. The content of organic matter is very low unless topsoil has been redistributed

throughout the area. As a result, preparing a seedbed is difficult and drought is a hazard. Reaction typically is moderately alkaline. In most areas these soils have a very low supply of available phosphorus and potassium.

These soils are better suited to small grain and to grasses and legumes for hay and pasture than to row crops. They are suited to row crops only in the areas where topsoil has been redistributed. The main crops are corn and soybeans. If cultivated crops are grown, erosion is a moderate or severe hazard in the more sloping areas. A system of conservation tillage that leaves crop residue on the surface helps to control erosion and stabilize the surface.

This map unit has not been assigned a land capability classification.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 99,000 acres in the county, or nearly 29 percent of the total acreage, meets the soil

requirements for prime farmland. Nearly all of this land is used for crops. The crops grown on this land, mainly corn and soybeans, account for an estimated 60 to 70 percent of the county's total agricultural income each year.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the

back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly

grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

According to the 1983 Iowa Agricultural Statistics, about 154,630 acres in Ringgold County, or 45 percent of the total acreage, is cropland. The main crops are corn and soybeans. Alfalfa or alfalfa-grass is the major hay crop. The acreage used for row crops has decreased in recent years. Productivity could be increased and soil conservation enhanced by application of crop production technology to most of the cropland in the county. This soil survey, which gives the basic characteristics of each kind of soil, can greatly aid in the application of this technology.

The main management needs on the cropland and pasture in Ringgold County are measures that help to control water erosion and soil blowing, improve drainage in naturally wet soils and seepy areas, and maintain or improve soil fertility and tilth.

Water erosion is the major problem on about two-thirds of the cropland and pasture in Ringgold County. It is a hazard if the slope is more than 2 percent. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on soils having a firm subsoil that is low in fertility, such as Shelby soils, and on soils having a firm clayey subsoil, such as Adair, Lamoni, and Clarinda soils. Preparing a good seedbed and tilling are difficult on eroded soils because the original friable surface layer has been removed or thinned and the more strongly structured subsoil commonly is hard and cloddy after rains or after it has been tilled when wet.

Runoff from eroding soils commonly deposits sediments in streams, drainageways, and road ditches.

Control of erosion not only helps to maintain the productivity of soils but also improves the quality of water for municipal use, for recreation, and for fish and wildlife by minimizing the pollution of streams.

Because of a great variety of soils and landscape features, various erosion-control measures are needed in Ringgold County. These measures minimize the impact of rainfall on bare soil, reduce the runoff rate, and increase the rate of water infiltration. Erosion can be controlled by conservation tillage, crop rotations that include grasses and legumes, contour farming, contour stripcropping, grassed waterways, cover crops, and terraces and diversions. Generally, a combination of several measures is needed.

If good management is applied, a permanent cover of hay or pasture plants can hold soil losses to an amount that will not reduce the productive capacity of the soils. On livestock farms, where part of the acreage is hayland or pasture, forage crops of grasses and legumes not only provide nitrogen and improve tilth for the next cropping season but also provide a protective plant cover.

A conservation tillage system that leaves a protective amount of crop residue on the surface after planting is effective in controlling erosion, especially on the more sloping soils. Following are examples of the major kinds of conservation tillage. No-till, slot, or zero tillage is a system in which the seedbed is prepared and the seed planted in one operation. The surface is disturbed only in the immediate area of the planted seed row. A protective cover of crop residue is left on at least 90 percent of the surface. Strip-till or till-plant also is a system in which the seedbed is prepared and the seed planted in one operation. Tillage is limited to a strip not wider than one-third of the row. A protective cover of crop residue is left on two-thirds of the surface. Chisel-disk or rotary tillage is a system in which the soil is loosened throughout the field and part of the crop residue is incorporated into the soil. Seedbed preparation and planting can be one or separate operations.

Terraces and diversions control runoff and erosion by reducing the length of slopes. They are most effective on well drained or moderately well drained, gently sloping and moderately sloping soils that have smooth slopes. They are less effective in areas where slopes are irregular or too steep. Intakes and tile outlets are needed to remove excess water from the terrace channels.

Terraces are effective on the soils that formed in loess, such as Arispe, Nira, and Pershing soils. They are not recommended on paleosols weathered from glacial till, such as Clarinda, Lamoni, and Adair soils. These soils have a firm, clayey subsoil and a low level

of productivity. If these soils are terraced along with the more productive soils upslope, minimizing the cuts helps to avoid unnecessary exposure of the subsoil. Terraces are somewhat effective on the soils that formed in glacial till, such as Shelby and Gara soils. In areas of these soils, slopes that are long and smooth and are less than 14 percent are generally better suited to terraces than other slopes. Minimizing the cuts helps to avoid unnecessary exposure of the firm subsoil, which is low in fertility. Medium to large stones from the subsoil can interfere with tillage.

If exposed by terrace cuts, the subsoil should be topdressed with surface soil material, which helps to maintain the productivity of the soils after construction. If terraces are constructed in eroded areas where the topsoil is generally less than 6 inches thick, the exposed subsoil cannot be adequately covered. As a result, tilth deteriorates, seedling cannot be easily established, and the fertility level and crop yields are reduced.

Contour farming and contour stripcropping are effective in controlling erosion in Ringgold County, especially on soils that have smooth, uniform slopes, such as Arispe, Grundy, Sharpsburg, and Nira soils. Gully-control structures, grassed waterways, and farm ponds help to control erosion in watercourses.

Soil blowing is a hazard on the sandy Dickinson soils, which are in scattered areas along the major streams. If winds are strong and the soils are dry and bare, soil blowing can damage these soils in a short period. Row crops on these soils and on the adjacent soils may be damaged by the windblown sand. A good plant cover, surface mulching, windbreaks, and conservation tillage minimize soil blowing.

Information about the design of conservation practices that help to control erosion and soil blowing on each kind of soil is available at the local office of the Soil Conservation Service.

Drainage is a major management concern on about 11 percent of the acreage in Ringgold County. Installing a drainage system on poorly drained and very poorly drained soils improves the timeliness of fieldwork, increases the soil temperature in the spring, expands the choice of crops that can be grown, and increases productivity.

A drainage system typically is needed on the Carlow, Wabash, Humeston, Zook, and Ackmore soils on flood plains and on the Winterset, Edina, and Haig soils on uplands. A tile drainage system generally does not function very satisfactorily in the very slowly permeable Carlow, Wabash, Humeston, Edina, and Haig soils. Zook soils can be adequately drained by tile drains if outlets are available. The drains may only slightly reduce the wetness, however, because permeability is

slow. Ackmore soils can be drained by tile if the silty alluvial material is thick enough for the tile to be installed on top of the clayey buried soil and if outlets are available.

Hillside seeps are common in the county. They are in areas between the soils that formed in loess, such as Clearfield, Arispe, and Nira soils, and the paleosols, such as Clarinda and Lamoni soils. They form when rainwater precolates through the soils that formed in loess and perches at the point where the loess comes in contact with the less permeable paleosols. The perched water moves laterally until it reaches the point where the loess-till contact is exposed, resulting in a wet, seepy area. The excess water can be removed by installing lateral interceptor tile in the more permeable loessial soils slightly upslope from the seepy area.

Fertility is affected by the supply of available phosphorus and potassium in the subsoil, by soil reaction, and by the content of organic matter in the surface layer. The fertility level varies widely in the soils of Ringgold County. In most of the soils, the supply of available phosphorus and potassium is low or very low and reaction is neutral to strongly acid.

On acid soils applications of ground limestone are needed to promote good plant growth. On all soils the kinds and amounts of lime and fertilizer needed should be determined by the results of soil tests, the needs of the crop, and the expected level of yields. Soil tests generally provide the most beneficial information. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime that should be applied.

Tilth is an important factor affecting the germination of seeds and the infiltration of water into soil. Soils with good tilth generally have a high content of organic matter and are granular and porous.

In most of the uneroded upland soils that formed under prairie grasses, the content of organic matter in the surface layer is about 3.0 to 4.5 percent. In the eroded upland soils that formed under prairie grasses, it is less than 1 percent to 3 percent, depending on the degree of erosion. It also is less than 1 percent to 3 percent in Gara, Armstrong, and Pershing soils, which formed under mixed prairie grasses and deciduous trees. Most of the soils on bottom land have the highest content of organic matter. The content is 4 to 7 percent, for example, in the soils that have a surface layer of silty clay loam or silty clay. It is 1 to 3 percent in the stratified soils that have a surface layer of silt loam, such as Nodaway soils. Regular additions of crop residue, manure, and other organic material improve soil structure and tilth and help to prevent the formation of a surface crust.

The soils that formed in glacial till, such as Gara and

Shelby soils, may have accumulations of large stones on the surface, especially in eroded areas. These stones can sometimes hinder fieldwork unless they are removed.

Most of the permanent pastures in the county support bluegrass. Some are renovated and support birdsfoot trefoil or crownvetch. In recent years fescue has been established on many of the pastures. Other suitable species that are common in the pastured areas are brome grass, reed canarygrass, orchardgrass, switchgrass, big bluestem, indiangrass, alfalfa, red clover, and ladino clover. Most of the bluegrass pastures are not used as cropland because the soils are too steep for cultivation. Measures that prevent overgrazing are needed, especially on steep slopes, to increase the rate of water infiltration and to prevent surface compaction and gully erosion. Maximum production of grasses and legumes can be achieved if the pasture is properly managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture in good condition.

Erosion is a severe hazard if the plant cover is removed when the more sloping pastures are renovated. Interseeding the grasses and legumes into the existing sod eliminates the need for removing the plant cover during seedbed preparation. If cultivated crops are to be grown prior to seeding, soil losses can be reduced by conservation tillage, contour farming, and grassed waterways.

Many field crops that are suited to the soils and climate in Ringgold County are not commonly grown. These include sorghum and milo, mainly for silage; wheat; barley; various pasture grasses; various native grasses, such as bluestem, switchgrass, and indiangrass, which can be used to produce grass seed; sweet corn; nursery stock; early vegetables; and certain orchard crops. The latest information about managing the soils for these crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and

results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (22). Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce

the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

The original land survey of Iowa, made during the period 1832 to 1859, indicated that at one time about 50,030 acres in Ringgold County was woodland. The early settlers cleared a large part of the woodland, primarily for farming. Some of the timber was felled for construction, firewood, and fenceposts. According to Forest Service surveys, the acreage of woodland declined to about 27,000 acres by 1954 and 15,200 acres by 1974. Most of the timber removed during the last 30 years was felled on strongly sloping to steep, highly erodible soils that were converted from woodland to agricultural uses.

The principal species on the upland slopes in the county are white oak, northern red oak, black oak, bur oak, shagbark hickory, bitternut hickory, honeylocust, and eastern redcedar. Those in the lowlands and along drainageways include eastern cottonwood, silver maple, willow, green ash, basswood, and black walnut. Black cherry, though common, is not plentiful. American elm and red elm are common, but they generally are small because of the effects of Dutch elm disease. Most of the timber on uplands grows on Lindley, Keswick, Weller, Gara, Pershing, and Armstrong soils. Most of the timber on bottom land grows in areas of the Nodaway-Humeston-Wabash association, which is described under the heading "General Soil Map Units."

High-grading is common in Ringgold County. It occurs when woodland owners tend to cut the better trees or the more desirable species for lumber and furniture. After this high-grading, the woodland is of poorer quality because it is regenerated by the poorer trees and the less desirable species left in the stand. Selective management of a stand of trees can result in the production of an increased volume of more valuable wood and in yields of a consistent amount of firewood from year to year. It also can greatly reduce soil losses and improve the habitat for wildlife.

Woodland can produce the best wood crop only if it is well managed. It should be protected from fire and from grazing. The best potential trees should be allowed to grow. The undesirable trees and vines that compete with the best trees for moisture, nutrients, and light should be removed. After some of the best trees are harvested, their growing space can be occupied by younger trees. The volume harvested during a designated period should not exceed the growth of the remaining trees during the same period.

Most of the woodland in the county is lightly to heavily pastured. Grazing of the woodland by livestock is not recommended. Livestock damage the base of the larger trees, damage or destroy young trees, and compact the soil. Also, they selectively browse certain young trees.

The soils in Ringgold County are generally suited or well suited to trees. Some tree species can grow under a variety of soil conditions, while others are more site specific. For example, eastern redcedar can grow in a poorly drained soil and in a droughty soil on a south-facing slope, whereas black walnut grows well only on a deep, moderately well drained, fertile soil. Generally, the deep, well drained or moderately well drained soils that are moderately fertile or highly fertile are well suited to trees. If the subsoil is slowly permeable, root development is restricted.

Further information about woodland management, tree planting, and insect and disease control can be

obtained from the Ringgold County Soil Conservation District and from the Iowa Conservation Commission.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; and *F*, a high content of rock fragments in the soil. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: *R*, *X*, *W*, *T*, *D*, *C*, *S*, and *F*.

In table 7, *slight*, *moderate*, and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted

because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class*. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil

is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning

recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject

to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Ringgold County supports many kinds of wildlife. These wildlife resources have a positive effect on the local economy, mainly because of the opportunities for hunting and fishing resulting from the kind and abundance of wildlife in the county. Also, songbirds and hawks, owls, snakes, and other predators are beneficial because they control rodents and undesirable insects.

The soils in the county indirectly affect the kind and abundance of wildlife through their effect on vegetation and land use. Topography affects wildlife through its effect on land use. The undisturbed vegetation in moderately steep and steep areas, such as most areas of Lindley soils, is valuable to wildlife. Planting suitable vegetation where needed on the more sloping prairie soils, such as Shelby soils, can improve the habitat for the desirable kinds of wildlife. The nearly level Edina, Haig, and Winterset soils generally are cropped intensively. They provide only limited shelter and nesting areas for wildlife, but they also provide corn and small grain for feed. Much of the wildlife in the county inhabits areas of the strongly sloping to steep Gara, Lindley, Shelby, Bucknell, Lamoni, Armstrong, Adair, and Keswick soils in the uplands. Because these soils are along the streams throughout the county, the wildlife is well distributed.

Raccoon, coyote, skunk, opossum, squirrel, and cottontail rabbit generally are abundant in the uplands and are especially abundant in areas of the Gara-Armstrong-Ladoga association, which is described under the heading "General Soil Map Units." White-tailed deer frequent all areas of the Gara-Armstrong-Pershing and Nodaway-Humeston-Wabash associations. They also frequent the adjacent wooded areas. Muskrat, mink, and beaver frequent the creeks throughout the county. They probably are most numerous in areas of the Nodaway-Humeston-Wabash association.

Quail and pheasants are plentiful throughout the county. Quail are most abundant in areas of the Gara-Armstrong-Pershing and Gara-Armstrong-Ladoga associations. The number of pheasants is highest in areas of the Nira-Sharpsburg-Shelby and Arispe-Shelby-Lamoni associations. The number of wild turkeys is increasing. The highest number of turkeys is in areas of the Lindley-Keswick association and in the wooded areas of the Gara-Armstrong-Pershing and Gara-Armstrong-Ladoga associations.

Ponds and reservoirs provide good habitat for waterfowl, particularly mallards, teal, and Canada geese. The larger streams support a good population of wood ducks. Areas of Wabash and Nodaway soils are potential sites for dikes and impoundments, which would improve the habitat for waterfowl. These areas are suitable sites for hunting blinds. The soils also provide food and cover for the waterfowl.

Fish, mainly catfish, bullheads, carp, and various minnows, are fairly plentiful in the major streams. Many privately owned farm ponds that range from 0.5 acre to 15 acres in size are well distributed throughout the county. Some well managed ones provide excellent habitat for bass, bluegill, and catfish. Internal drainage, texture of the subsoil, and permeability are important factors affecting the selection of sites for stocked farm ponds and the development of habitat for waterfowl. Municipal reservoirs provide excellent opportunities for fishing and enhance the habitat for wildlife. Many areas of the Gara-Armstrong-Pershing association adjacent to the reservoirs are suitable for food plots, which improve the habitat for waterfowl.

Although many areas in the county are suitable as wildlife habitat, many more could be improved or developed. Generally, some soils on each farm provide good wildlife habitat if they are properly managed. Small, irregularly shaped areas of limited value for other uses can be developed as wildlife habitat. Examples are many areas of the strongly sloping to steep Adair, Armstrong, Gara, and Lindley soils. Brushy or wooded areas can be fenced so that food and cover are not destroyed by livestock. The borders of fields can be planted to grasses and legumes. These should not be clipped, especially during the nesting season of upland birds.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or

very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, brome grass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian olive, autumn olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use

planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreation uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm, dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding,

large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of calcium carbonate affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils.

Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or

cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, and bedrock.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment (fig. 13). Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the



Figure 13.—Farm ponds in Ringgold County provide water for livestock in most years.

storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed

only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and

depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct

surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27

percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (2) and the system adopted by the American Association of State Highway and Transportation Officials (1).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in

the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $\frac{1}{3}$ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and

root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2

millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17. Only saturated zones within a depth of about 6 feet are indicated.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water

table is separated from a lower one by a dry zone.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (23). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Fluvaquents (*Fluv*, meaning flood plain, plus *aquent*, the suborder of the Entisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Aerice Fluvaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and

other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, nonacid, mesic Aerice Fluvaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (21). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (23). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Ackmore Series

The Ackmore series consists of somewhat poorly drained, moderately permeable soils on alluvial fans and bottom land. These soils formed in silty alluvium. The native vegetation was tall prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Ackmore silt loam, 0 to 2 percent slopes, in a cultivated field; 1,470 feet west and 690 feet north of the southeast corner of sec. 18, T. 70 N., R. 30 W.

- Ap—0 to 8 inches; stratified very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silt loam (25 percent clay), grayish brown (10YR 5/2) dry; appears massive but has vertical cleavage planes; friable; neutral; clear smooth boundary.
- C—8 to 32 inches; stratified very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), and grayish brown (10YR 5/2) silt loam (26 percent clay); few fine distinct dark yellowish brown (10YR 4/6) mottles; appears massive but has vertical cleavage planes; friable; few strong brown (7.5YR 4/6) iron stains; neutral; clear smooth boundary.
- 2Ab1—32 to 40 inches; black (N 2/0) silty clay loam (32 percent clay); weak medium prismatic structure parting to weak and moderate fine subangular blocky; friable; many distinct pressure faces; neutral; gradual smooth boundary.
- 2Ab2—40 to 52 inches; black (N 2/0) silty clay loam (38 percent clay); moderate medium and fine prismatic structure parting to moderate fine subangular blocky; firm; many distinct pressure faces; neutral; gradual smooth boundary.
- 2Ab3—52 to 60 inches; very dark gray (10YR 3/1) silty clay loam (37 percent clay); weak medium prismatic structure; firm; few distinct black (N 2/0) pressure faces; neutral.

Depth to the 2Ab horizon ranges from 20 to 36 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. The strata in the C horizon have value of 2 to 5. They range from silt loam to silty clay loam. The 2Ab horizon is neutral in hue or has hue of 10YR. It has value of 2 or 3 and chroma of 0 or 1. It ranges from 27 to 38 percent clay.

Adair Series

The Adair series consists of moderately well drained, slowly permeable soils on convex, narrow shoulder slopes and side slopes in the uplands. These soils formed in loess or erosional sediments over a reddish, clayey paleosol that weathered from glacial till. The native vegetation was tall prairie grasses. Slope ranges from 5 to 14 percent.

Typical pedon of Adair clay loam, 5 to 9 percent slopes, in a pasture on a north-facing, convex interfluvium; 2,490 feet east and 1,950 feet south of the northwest corner of sec. 15, T. 70 N., R. 29 W.

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2)

clay loam (about 30 percent clay), very dark grayish brown (10YR 3/2) dry; black (10YR 2/1) coatings on faces of peds; weak fine granular structure; friable; common fine roots; neutral; clear smooth boundary.

- AB—8 to 13 inches; dark brown (10YR 3/3) clay loam (about 32 percent clay), dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) dry; very dark gray (10YR 3/1) coatings on faces of peds; weak fine granular structure; friable; common fine roots; neutral; clear smooth boundary.
- 2Bt1—13 to 20 inches; dark brown (7.5YR 4/4) clay loam (about 38 percent clay); very dark gray (10YR 3/1) coatings on faces of peds; common medium prominent yellowish red (5YR 4/6) mottles; weak fine and medium subangular blocky structure; friable; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; common fine roots; about 5 percent 5-millimeter pebbles; slightly acid; clear smooth boundary.
- 2Bt2—20 to 28 inches; brown (7.5YR 4/4) clay (about 43 percent clay); few dark gray (10YR 4/1) coatings on faces of peds; few fine distinct dark gray (10YR 4/1) and common medium prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; firm; thin continuous brown (10YR 4/3) clay films on faces of peds; few very fine roots; few fine dark concretions of manganese oxide; about 6 percent 5-millimeter pebbles; slightly acid; gradual smooth boundary.
- 2Bt3—28 to 34 inches; mottled yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) clay loam (about 39 percent clay); weak medium prismatic structure parting to weak medium subangular blocky; firm; thin continuous grayish brown (10YR 5/2) clay films on faces of peds; few very fine roots; few fine dark concretions of manganese oxide; about 4 percent 5-millimeter pebbles; slightly acid; gradual smooth boundary.
- 2BC—34 to 51 inches; mottled yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) clay loam (about 37 percent clay); weak medium prismatic structure; firm; few faint grayish brown (10YR 5/2) clay films on vertical faces of peds; common fine dark concretions of manganese oxide; about 4 percent 5-millimeter pebbles; neutral; clear smooth boundary.
- 2C—51 to 60 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) clay loam (about 33 percent clay); appears massive but has some vertical pressure faces; firm; thin discontinuous brown (10YR 4/3) clay flows along vertical faces of peds; few fine dark concretions of manganese oxide; few medium accumulations of calcium carbonate; about 4 percent 5-millimeter pebbles;

strongly effervescent; mildly alkaline.

The thickness of the solum ranges from 40 to more than 65 inches. Carbonates are leached to a depth of at least 48 inches and typically to about 50 inches or more. A few stones and pebbles are throughout the profile.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly loam or clay loam but in some pedons is silty clay loam. It generally is 10 to 16 inches thick but is thinner in eroded areas. The upper part of the 2Bt horizon dominantly has hue of 2.5YR to 10YR, value of 3 to 5, and chroma of 3 to 6 in the matrix and in the mottles. The content of clay typically is 38 to 46 percent but ranges to 55 percent. The lower part of the 2Bt horizon and the 2BC horizon typically have hue of 10YR in the matrix and hue of 5YR to 5Y in the mottles.

The moderately eroded Adair soils in this county do not have a mollic epipedon, which is definitive for the series.

Arispe Series

The Arispe series consists of somewhat poorly drained, moderately slowly permeable soils on short, convex side slopes and the lower, narrow ridges in the uplands. These soils formed in loess 4 to 8 feet deep over a gray, clayey paleosol. The native vegetation was tall prairie grasses. Slope ranges from 5 to 9 percent.

Typical pedon of Arispe silty clay loam, 5 to 9 percent slopes, in a hayfield on a northeast-facing, convex side slope near the head of a drainageway; 1,460 feet east and 1,550 feet north of the southwest corner of sec. 7, T. 70 N., R. 29 W.

- Ap—0 to 6 inches; black (10YR 2/1) silty clay loam (about 29 percent clay), dark gray (10YR 4/1) and gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; common fine and few medium roots; neutral; clear smooth boundary.
- A—6 to 10 inches; very dark gray (10YR 3/1) silty clay loam (about 31 percent clay), dark gray (10YR 4/1) dry; mixed with about 10 percent pockets of dark grayish brown (2.5Y 4/2) subsoil material; black (10YR 2/1) coatings on faces of peds; moderate very fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.
- Bt1—10 to 16 inches; dark grayish brown (2.5Y 4/2) silty clay loam (about 37 percent clay); very dark gray (10YR 3/1) coatings on faces of peds; few fine faint olive yellow (2.5Y 6/6) mottles; weak fine subangular blocky structure parting to moderate very fine subangular blocky; friable; few distinct dark gray (10YR 4/1) clay films on faces of peds;

few fine roots; few dark concretions of manganese oxide; medium acid; clear smooth boundary.

- Bt2—16 to 23 inches; grayish brown (2.5Y 5/2) silty clay loam (about 36 percent clay); common medium distinct brownish yellow (10YR 6/6) and medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to moderate very fine subangular blocky; firm; few distinct dark gray (10YR 4/1) clay films on faces of peds; few fine roots; common dark concretions of manganese oxide; medium acid; gradual smooth boundary.
- Bt3—23 to 33 inches; grayish brown (2.5Y 5/2) silty clay loam (about 34 percent clay); common medium distinct brownish yellow (10YR 6/6) and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to moderate fine subangular blocky; firm; few distinct clay films on faces of peds; few fine roots; common dark concretions of manganese oxide; slightly acid; gradual smooth boundary.
- Bt4—33 to 48 inches; grayish brown (2.5Y 5/2) silty clay loam (about 32 percent clay); common medium distinct brownish yellow (10YR 6/6) and common medium prominent yellowish brown (10YR 5/6) mottles; weak medium and fine prismatic structure parting to weak medium subangular blocky; firm; many distinct olive gray (5Y 5/2) clay films on faces of peds; few fine roots; common dark concretions of manganese oxide; slightly acid; gradual smooth boundary.
- BC—48 to 60 inches; light olive gray (5Y 6/2) silty clay loam (about 30 percent clay); common medium prominent strong brown (7.5YR 4/6) and common medium faint olive yellow (2.5Y 6/6) mottles; weak medium prismatic structure; firm; few distinct olive gray (5Y 5/2) clay films on faces of peds; few fine roots; few dark concretions of manganese oxide; slightly acid.

The thickness of the solum ranges from 36 to more than 60 inches. The solum is leached of free carbonates.

The A and Ap horizons have value of 2 or 3 and chroma of 1 or 2. They generally are 10 to 18 inches thick but are thinner in eroded areas. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 or 3. The BC horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. The maximum clay content is at a depth of 10 to 18 inches. It typically ranges from 35 to 42 percent.

The moderately eroded Arispe soils in this county do not have a mollic epipedon, which is definitive for the series.

Armstrong Series

The Armstrong series consists of moderately well drained, slowly permeable soils on convex, narrow ridges and shoulder slopes and side slopes in the uplands. These soils formed in loess or erosional sediments over a reddish, clayey paleosol that weathered from glacial till. The native vegetation was mixed grasses and trees. Slope ranges from 5 to 14 percent.

Typical pedon of Armstrong clay loam, 5 to 9 percent slopes, moderately eroded, in a pasture on a southwest-facing, convex, narrow interfluvium; 100 feet east and 300 feet south of the northwest corner of sec. 9, T. 70 N., R. 28 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) and dark gray (10YR 3/1) clay loam (about 28 percent clay), grayish brown (10YR 5/2) and dark gray (10YR 4/1) dry, very dark grayish brown (10YR 3/2) rubbed; mixed with 15 to 20 percent pockets of dark yellowish brown (10YR 4/4) subsoil material; weak fine granular structure; friable; light brownish gray (10YR 6/2) silt coatings on faces of peds; common fine roots; medium acid; abrupt smooth boundary.

BE—8 to 12 inches; dark yellowish brown (10YR 4/4) clay loam (about 29 percent clay); very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; few fine roots; about 5 percent 5-millimeter pebbles; strongly acid; clear smooth boundary.

Bt1—12 to 18 inches; mottled yellowish brown (10YR 5/6), dark grayish brown (10YR 4/2), and yellowish red (5YR 4/6) clay loam (about 36 percent clay); moderate fine subangular blocky structure; friable; many distinct dark brown (10YR 4/3) clay films on faces of peds; few fine roots; about 4 percent 5-millimeter pebbles; very strongly acid; clear smooth boundary.

Bt2—18 to 24 inches; mottled yellowish brown (10YR 5/6), grayish brown (10YR 5/2), and red (2.5YR 4/6) clay loam (about 37 percent clay); moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; many prominent grayish brown (2.5Y 5/2) clay films on faces of peds; few fine roots; few fine dark concretions of manganese oxide; about 5 percent 5-millimeter pebbles; very strongly acid; gradual smooth boundary.

Bt3—24 to 32 inches; mottled yellowish brown (10YR 5/6), grayish brown (10YR 5/2), and red (2.5YR 4/6) clay loam (about 36 percent clay); moderate medium subangular blocky structure parting to

moderate fine angular blocky; firm; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few fine roots; few fine dark concretions of manganese oxide; about 2 percent 3- to 5-millimeter pebbles; very strongly acid; gradual smooth boundary.

Bt4—32 to 45 inches; mottled strong brown (7.5YR 5/6) and grayish brown (2.5Y 5/2) clay loam (about 32 percent clay); weak medium prismatic structure parting to weak medium subangular blocky; firm; few distinct grayish brown (10YR 5/2) clay films on faces of peds; very few fine roots; common fine dark concretions of manganese oxide; about 2 percent 4-millimeter pebbles; slightly acid; gradual smooth boundary.

BC—45 to 60 inches; mottled strong brown (7.5YR 5/6), light brownish gray (2.5Y 6/2), and grayish brown (2.5Y 5/2) clay loam (about 31 percent clay); appears massive but has some vertical cleavage planes; firm; common fine dark concretions of manganese oxide; about 3 percent 4-millimeter pebbles; neutral.

The thickness of the solum and the depth to free carbonates commonly range from about 42 to 65 inches. A few stones and pebbles are throughout the profile.

The A or Ap horizon has chroma of 1 or 2. It typically is 6 to 8 inches thick. It is loam, silt loam, silty clay loam, or clay loam. Some pedons have an E horizon. This horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is 2 to 5 inches thick. It is loam or silt loam. The part of the Bt horizon that has reddish mottles or matrix colors is commonly 18 to 32 inches thick and has a clay content of 36 to 45 percent. The Bt horizon typically has hue of 10YR, 7.5YR, or 5YR, value of 4 or 5, and chroma of 3 to 6. The BC and C horizons, if they occur, have hue of 2.5Y or 7.5YR, value of 4 or 5, and chroma of 3 to 6.

The moderately eroded Armstrong soils in this county have a thinner dark surface layer than is definitive for the series.

Bucknell Series

The Bucknell series consists of somewhat poorly drained, slowly permeable soils on short, convex ridges, side slopes, and shoulder slopes in the coves of drainageways on uplands. These soils formed in a truncated, gray, clayey paleosol that weathered from glacial till. The native vegetation was mixed grasses and trees. Slope ranges from 5 to 14 percent.

Typical pedon of Bucknell silty clay loam, 9 to 14 percent slopes, in a hayfield on a northeast-facing,

convex side slope near the head of a drainageway; 1,580 feet west and 490 feet south of the northeast corner of sec. 22, T. 70 N., R. 30 W.

- Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam (about 30 percent clay), grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; friable; few faint dark grayish brown (10YR 4/2) silt coatings on faces of peds; common fine roots; neutral; clear smooth boundary.
- BE—8 to 14 inches; dark grayish brown (10YR 4/2) clay loam (about 38 percent clay); very dark gray (10YR 3/1) coatings on faces of peds; few fine distinct olive brown (2.5Y 4/4) and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to moderate fine angular blocky; friable; common fine roots; medium acid; clear smooth boundary.
- Btg1—14 to 27 inches; dark gray (10YR 4/1) and gray (10YR 5/1) clay (about 42 percent clay); common fine distinct olive brown (2.5Y 4/4) and few fine faint yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; firm; few distinct dark gray (10YR 4/1) clay films on faces of peds; few fine roots; common white nodules; about 1 percent fine pebbles; strongly acid; gradual smooth boundary.
- Btg2—27 to 33 inches; grayish brown (5Y 5/2) clay loam (about 38 percent clay); common fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few distinct gray (10YR 5/1) clay films on faces of peds; few fine roots; few strong brown concretions of iron oxide; common fine, white (10YR 4/1), hard, noncalcareous nodules; about 1 percent fine pebbles; medium acid; gradual smooth boundary.
- Btg3—33 to 46 inches; grayish brown (5Y 5/2) clay loam (about 37 percent clay); common fine prominent yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; firm; few distinct gray (10YR 5/1) clay films on faces of peds; common strong brown (7.5YR 5/8) concretions of iron oxide; common fine, white (10YR 8/1), hard, noncalcareous nodules; about 1 percent fine pebbles; medium acid; clear smooth boundary.
- C—46 to 60 inches; mottled gray (5Y 5/1), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/8) clay loam (about 37 percent clay); appears massive but has some vertical cleavage planes; firm; yellowish red (5YR 5/8) concretions of iron oxide; about 1 percent fine pebbles; neutral.

The thickness of the solum typically ranges from 40

to 60 inches. The soils have no carbonates within a depth of 60 inches. A few stones and pebbles are throughout the profile.

The A or Ap horizon typically has value of 2 or 3 and chroma of 1 or 2. It is dominantly silty clay loam but in some pedons is clay loam or loam. Some pedons have an E horizon. This horizon has value of 4 or 5 and chroma of 2 or 3. It is 2 to 5 inches thick. It is silt loam or silty clay loam. In cultivated or eroded areas, the E horizon has been incorporated into the Ap horizon. It is evident only as silt coatings on faces of peds. The Btg2 and Btg3 horizons generally are mottled and have hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 to 8. The maximum clay content may reach 50 percent and generally is at a depth of 10 to 18 inches.

The moderately eroded Bucknell soils in this county have a thinner dark surface layer than is definitive for the series.

Caleb Series

The Caleb series consists of moderately well drained, moderately permeable soils on convex side slopes and concave foot slopes in the uplands and on the escarpments of high stream benches. These soils formed in alluvium. The native vegetation was mixed grasses and trees. Slope ranges from 9 to 25 percent.

Typical pedon of Caleb loam, 9 to 14 percent slopes, moderately eroded, in a hayfield on a southwest-facing, convex side slope; 2,040 feet west and 240 feet north of the southeast corner of sec. 2, T. 70 N., R. 28 W.

- Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) loam (about 25 percent clay and 25 percent sand), grayish brown (10YR 5/2) dry; mixed with about 15 percent streaks and pockets of dark yellowish brown (10YR 4/4) subsoil material; dark grayish brown (10YR 4/2) coatings on faces of peds; moderate thin platy structure parting to moderate fine angular blocky; friable; light gray (10YR 6/1 dry) silt coatings on faces of peds; few fine roots; neutral; abrupt smooth boundary.
- Bt1—6 to 10 inches; dark yellowish brown (10YR 4/4) clay loam (about 30 percent clay and 30 percent sand); weak medium subangular structure parting to moderate fine angular blocky; firm; many distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; thin discontinuous dark grayish brown (10YR 4/2) coatings in root channels; few fine roots; medium acid; gradual smooth boundary.
- Bt2—10 to 17 inches; yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/6) clay loam (about 35 percent clay and 30 percent sand); moderate medium subangular and angular blocky structure

parting to moderate fine angular blocky; firm; many distinct brown (7.5YR 4/4) clay films on faces of peds; very few very fine roots; medium acid; gradual smooth boundary.

Bt3—17 to 25 inches; yellowish brown (10YR 5/6) sandy clay loam (about 32 percent clay and 50 percent sand); weak medium subangular blocky structure parting to weak fine angular blocky; friable; many distinct brown (7.5YR 4/4) clay films on faces of peds; light brownish gray (10YR 6/2) uncoated sand grains on vertical faces of peds; very few very fine roots; strongly acid; gradual smooth boundary.

Bt4—25 to 36 inches; yellowish brown (10YR 5/6) sandy clay loam (23 percent clay and 60 percent sand); weak medium subangular blocky structure; friable; common distinct brown (7.5YR 4/4) clay films on faces of peds; light brownish gray (10YR 6/2) uncoated sand grains on vertical faces of peds; strongly acid; gradual smooth boundary.

BC—36 to 49 inches; yellowish brown (10YR 5/6) sandy loam (about 18 percent clay and 75 percent sand); common medium distinct light brownish gray (10YR 6/2) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; friable; light gray (10YR 7/1) uncoated sand grains on vertical faces of peds; strongly acid; gradual smooth boundary.

C—49 to 60 inches; mottled brown (10YR 4/3), strong brown (7.5YR 4/6), and grayish brown (10YR 5/2) sandy clay loam (about 22 percent clay and 70 percent sand); appears massive but has some vertical cleavage planes; friable; light gray (10YR 7/1) uncoated sand grains on vertical cleavage planes; medium acid.

Typically, the solum is 5 or more feet thick, but it is as thin as 42 inches in some pedons. The soils have no carbonates within a depth of 5 feet.

The A or Ap horizon typically has chroma of 1 or 2. It generally is loam but ranges from loam to clay loam. The Ap horizon is typically 6 to 9 inches thick. Some pedons have an E horizon. This horizon has value of 4 or 5 and chroma of 2 or 3. It is 2 to 4 inches thick. It is silt loam or loam. The Bt horizon typically has chroma of 3 to 6. The BC and C horizons vary in texture over short distances. They are clay loam, loam, or sandy clay loam. Thin strata of sandy loam and loamy sand or coarser sand are below a depth of 3 to more than 4 feet in some pedons.

The moderately eroded Caleb soils in this county do not have a dark surface layer, which is definitive for the series.

Carlow Series

The Carlow series consists of very poorly drained, very slowly permeable soils on bottom land along the major streams. These soils formed in clayey alluvium. The native vegetation was mixed grasses and trees. Slope ranges from 0 to 2 percent.

Typical pedon of Carlow silty clay, 0 to 2 percent slopes, in a cultivated field on a flood plain; 1,120 feet west and 2,140 feet south of the northeast corner of sec. 22, T. 69 N., R. 31 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay (43 percent clay), very dark grayish brown (10YR 3/2) rubbed, dark gray (10YR 4/1) and gray (10YR 5/1) dry; moderate fine subangular blocky structure; friable; few fine roots; slightly acid; clear smooth boundary.

A—9 to 17 inches; very dark gray (10YR 3/1) silty clay (51 percent clay), gray (10YR 5/1) dry, very dark gray (10YR 3/1) rubbed; black (10YR 2/1) coatings on faces of peds; few fine faint dark grayish brown (10YR 4/2) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; few fine roots; strongly acid; gradual smooth boundary.

Bg1—17 to 25 inches; dark gray (10YR 4/1) clay (62 percent clay), dark gray (10YR 4/1) rubbed; few fine faint dark grayish brown (10YR 4/2) and few fine prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; very dark gray (10YR 3/1) pressure faces; few fine roots; strongly acid; gradual smooth boundary.

Bg2—25 to 34 inches; dark gray (10YR 4/1) clay, (65 percent clay), dark gray (10YR 4/1) rubbed; few medium distinct olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to moderate medium and fine subangular blocky; firm; very dark gray (10YR 3/1) pressure faces; few fine roots; medium acid; gradual smooth boundary.

Bg3—34 to 45 inches; gray (10YR 5/1) silty clay (54 percent clay); common fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; dark gray (10YR 4/1) pressure faces; some dark gray (10YR 4/1) and very dark gray (10YR 3/1) coatings in root channels; slightly acid; gradual smooth boundary.

Bg4—45 to 60 inches; gray (10YR 5/1) silty clay (48 percent clay); common fine distinct strong brown (7.5YR 5/6) and fine medium faint olive brown (2.5Y 4/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky;

firm; pressure faces; dark gray (10YR 4/1) coatings in root channels; slightly acid.

The solum ranges from 30 to more than 60 inches in thickness. The mollic epipedon is 10 to 20 inches thick.

The A horizon has hue of 10YR, 2.5Y, or 5Y and chroma of 2 or less. The A horizon typically is silty clay but is silty clay loam in some pedons. Also, in some areas silt loam overwash phases are recognized. The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 2 or less. The mottles in this horizon have hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 8. The control section typically is silty clay or clay. It ranges from 48 to 60 percent clay.

Clarinda Series

The Clarinda series consists of poorly drained, very slowly permeable soils on short, convex side slopes and on the lower ridges in coves at the head of drainageways on uplands that border major drainage divides. These soils formed in a gray, clayey paleosol that weathered from glacial till. The native vegetation was tall prairie grasses. Slope ranges from 5 to 14 percent.

Typical pedon of Clarinda silty clay loam, 5 to 9 percent slopes, in a hayfield on an east-facing, convex side slope in the uplands; 1,490 feet east and 520 feet north of the southwest corner of sec. 32, T. 70 N., R. 31 W.

Ap—0 to 6 inches; black (10YR 2/1) silty clay loam (34 percent clay), very dark gray (10YR 3/1) and dark gray (10YR 4/1) dry; moderate fine granular and moderate fine subangular blocky structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A—6 to 11 inches; very dark gray (10YR 3/1) silty clay loam (36 percent clay), dark gray (10YR 4/1) and gray (10YR 6/1) dry; weak fine subangular blocky and weak fine granular structure; friable; common fine roots; medium acid; clear smooth boundary.

2Btg1—11 to 19 inches; dark gray (10YR 4/1) silty clay (48 percent clay); common fine distinct yellowish brown (10YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; moderate medium and fine subangular blocky structure parting to moderate very fine subangular blocky; firm; common distinct clay films on faces of peds; few fine roots; strongly acid; clear smooth boundary.

2Btg2—19 to 31 inches; dark gray (10YR 4/1) silty clay (50 percent clay); common fine distinct yellowish brown (10YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; very dark gray (N 3/0) coatings

on faces of peds; moderate medium subangular blocky structure; very firm; many distinct clay films on faces of peds; few fine roots; slightly acid; gradual smooth boundary.

2Btg3—31 to 39 inches; gray (10YR 5/1) silty clay (53 percent clay); common fine distinct yellowish brown (10YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky; very firm; many prominent dark gray (10YR 4/1) clay films and few white (10YR 8/1 dry) silt coatings on faces of peds; neutral; gradual smooth boundary.

2Btg4—39 to 53 inches; gray (10YR 5/1) silty clay (50 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; very firm; many distinct continuous dark gray (10YR 4/1) clay films on faces of peds; neutral; gradual smooth boundary.

2Btg5—53 to 60 inches; mottled gray (10YR 5/1), strong brown (7.5YR 5/6), and yellowish brown (10YR 5/6) silty clay (46 percent clay); weak medium prismatic structure parting to moderate fine angular blocky; very firm; common distinct continuous dark gray (10YR 4/1) clay films on faces of peds; few fine dark concretions of manganese oxide; neutral.

The thickness of the solum and the depth to carbonates commonly are more than 5 feet.

The A horizon is typically 10 to 15 inches thick but is thinner in eroded areas. The 2Btg horizon has hue of 10YR, 2.5Y, or 5Y. It has hue of 7.5YR and 5YR only in mottles. It is silty clay or clay. The content of clay in this horizon ranges from 45 to 60 percent.

The moderately eroded Clarinda soils in this county do not have a mollic epipedon, which is definitive for the series.

Clearfield Series

The Clearfield series consists of poorly drained, moderately slowly permeable soils on short, narrow, convex ridgetops and convex side slopes near the head of drainageways on uplands. These soils formed in deoxidized loess 3 to 5 feet deep over a gray, clayey paleosol. The native vegetation was tall prairie grasses. Slope ranges from 5 to 9 percent.

Typical pedon of Clearfield silty clay loam, 5 to 9 percent slopes, in a cultivated field on a southeast-facing, convex side slope near the head of a drainageway; 62 feet west and 1,270 feet south of the northeast corner of sec. 6, T. 69 N., R. 31 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam

(about 31 percent clay), dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few fine roots; medium acid; clear smooth boundary.

A—9 to 14 inches; very dark gray (10YR 3/1) silty clay loam (about 33 percent clay), gray (10YR 5/1) dry; black (10YR 2/1) coatings on faces of peds; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure parting to moderate fine subangular blocky; friable; few fine roots; neutral; clear smooth boundary.

Btg1—14 to 19 inches; dark gray (10YR 4/1) silty clay loam (about 36 percent clay); common fine distinct olive brown (2.5Y 4/4) and few fine distinct light olive brown (2.5Y 5/4) mottles; moderate medium subangular blocky structure; firm; few distinct clay films on faces of peds; few fine roots; neutral; clear smooth boundary.

Btg2—19 to 30 inches; gray (10YR 5/1) silty clay loam (about 35 percent clay); common fine distinct light olive brown (2.5Y 5/4) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; friable; few distinct dark gray (10YR 4/1) clay films on faces of peds; few fine roots; neutral; gradual smooth boundary.

Btg3—30 to 40 inches; light brownish gray (2.5Y 6/2) silty clay loam (about 32 percent clay); common fine and medium distinct light olive brown (2.5Y 5/6) and common fine prominent strong brown (7.5YR 5/8) mottles; moderate fine prismatic structure parting to weak medium subangular blocky; friable; few distinct gray (10YR 5/1) clay in root channels; few fine roots; few fine dark concretions of manganese oxide; neutral; clear smooth boundary.

BCg—40 to 48 inches; dark gray (5Y 4/1) silty clay loam (about 36 percent clay); few fine distinct olive brown (2.5Y 4/4) mottles; weak medium prismatic structure; firm; few fine roots; few fine strong brown (7.5YR 5/8) concretions of iron oxide; neutral; clear smooth boundary.

2Bg—48 to 60 inches; gray (5Y 5/1) silty clay (about 44 percent clay); fine distinct light olive brown (2.5Y 5/6) mottles; weak coarse prismatic structure; firm; few fine roots; neutral.

The solum typically is about 4 feet thick but ranges from 3 to 5 feet in thickness over the Yarmouth-Sangamon clayey paleosol. It has no carbonates. By weighted average, the content of clay in the control section is generally about 35 percent but ranges from 35 to 40 percent.

The A horizon typically is neutral in hue or has hue of 10YR. It has chroma of 0 or 1. It typically is 10 to 18 inches thick but is thinner in eroded areas. The Btg

horizon has hue of 10YR, 2.5Y, or 5Y. Mottles that have high chroma are throughout the B horizon.

The moderately eroded Clearfield soils in this county do not have a mollic epipedon, which is definitive for the series.

Dickinson Series

The Dickinson series consists of well drained soils on ridges and side slopes in the uplands. These soils formed in loamy eolian sediments. Permeability is moderately rapid in the solum and rapid in the substratum. The native vegetation was tall prairie grasses. Slope ranges from 5 to 14 percent.

Typical pedon of Dickinson fine sandy loam, 9 to 14 percent slopes, in a permanent pasture on a west-facing, convex side slope on uplands; 1,780 feet east and 233 feet north of the southwest corner of sec. 36, T. 68 N., R. 31 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry, very dark grayish brown (10YR 3/2) crushed; 5 to 10 percent brown (10YR 4/3) pockets; weak fine granular structure; very friable; common fine roots; neutral; clear smooth boundary.

A—8 to 15 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) dry, very dark grayish brown (10YR 3/2) crushed; weak fine subangular blocky structure; very friable; common fine roots; neutral; clear smooth boundary.

Bw1—15 to 23 inches; yellowish brown (10YR 5/4) fine sandy loam; weak fine subangular blocky structure; very friable; common fine roots; slightly acid; gradual smooth boundary.

Bw2—23 to 37 inches; yellowish brown (10YR 5/4) fine sandy loam; weak medium subangular blocky structure; very friable; few fine roots; medium acid; gradual smooth boundary.

C1—37 to 46 inches; yellowish brown (10YR 5/4) loamy fine sand; single grain; loose; few fine roots; medium acid; gradual smooth boundary.

C2—46 to 60 inches; yellowish brown (10YR 5/6) loamy fine sand; single grain; loose; slightly acid.

The thickness of the solum ranges from 20 to 48 inches. The A horizon is 10 to 18 inches thick. It has value of 2 or 3 and chroma of 1 to 3. The Bw horizon has value of 3 to 5 and chroma of 3 to 6. The C horizon generally ranges from loamy fine sand to fine sand. In some pedons, however, it has few lamellae of sandy loam or sandy clay loam at a depth of more than 40

inches. The lamellae are about 1 to 6 inches thick.

Edina Series

The Edina series consists of poorly drained, very slowly permeable soils in slightly depressional areas on broad flats in the uplands. These soils formed in loess. The native vegetation was tall prairie grasses. Slope is 0 to 1 percent.

Typical pedon of Edina silt loam, 0 to 1 percent slopes, in a cultivated field in a slightly depressional area of a broad upland divide; 720 feet west and 1,130 feet south of the northeast corner of sec. 21, T. 70 N., R. 29 W.

- Ap—0 to 9 inches; black (10YR 2/1) and dark gray (10YR 4/1) silt loam (27 percent clay), dark gray (10YR 4/1) dry, very dark gray (10YR 3/1) rubbed; moderate fine granular structure; friable; light gray (10YR 7/1 dry) silt coatings; common fine roots; slightly acid; clear smooth boundary.
- E—9 to 15 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silt loam (22 percent clay), light gray (10YR 7/1) dry; very dark gray (10YR 3/1) coatings on faces of peds; few fine distinct light olive brown (2.5Y 5/4) mottles; weak thin platy structure; friable; light gray (10YR 7/1 dry) silt coatings on faces of peds; few fine roots; slightly acid; clear smooth boundary.
- Btg1—15 to 25 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) silty clay (49 percent clay); common fine distinct yellowish brown (10YR 5/4) mottles; weak fine and medium subangular blocky structure; firm; many distinct very dark gray (10YR 3/1) clay films on faces of peds; few fine roots; few strong brown (7.5YR 5/8) concretions of iron oxide; medium acid; clear smooth boundary.
- Btg2—25 to 36 inches; gray (10YR 5/1) silty clay (50 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; common distinct dark gray (10YR 4/1) clay films on faces of peds; few fine roots; few strong brown (7.5YR 5/8) concretions of iron oxide; slightly acid; gradual smooth boundary.
- Btg3—36 to 45 inches; grayish brown (2.5Y 5/2) silty clay (44 percent clay); few fine distinct yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; firm; common distinct dark gray (10YR 4/1) clay films on faces of peds; few fine dark concretions of manganese oxide; few fine strong brown (7.5YR 5/8) concretions of iron oxide at a depth of 37 to 43 inches; slightly acid; gradual smooth boundary.
- BCg—45 to 60 inches; grayish brown (2.5Y 5/2) silty

clay loam (38 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few distinct dark gray (10YR 4/1) clay in root channels; common dark concretions of manganese oxide; common strong brown (7.5YR 5/8) concretions of iron oxide; neutral.

The thickness of the solum ranges from 40 to more than 60 inches. By weighted average, the content of clay in the control section is generally about 49 percent but ranges from 45 to 60 percent. The solum has no carbonates.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. It typically is 8 to 12 inches thick. The E horizon has chroma of 1 or 2. It typically is 6 to 10 inches thick. In some cultivated areas it is partly incorporated into the Ap horizon. The upper part of the Bt horizon has hue of 2.5Y or 10YR and value of 2 or 3. The lower part has hue of 2.5Y, 10YR, or 5Y and value of 3 to 5.

Ely Series

The Ely series consists of somewhat poorly drained, moderately permeable soils on low, slightly concave foot slopes and alluvial fans. These soils formed in silty local alluvium. The native vegetation was tall prairie grasses. Slope ranges from 2 to 5 percent.

Typical pedon of Ely silty clay loam, 2 to 5 percent slopes, in a permanent pasture on an east-facing, slightly concave foot slope; 150 feet west and 56 feet north of the southeast corner of sec. 4, T. 69 N., R. 31 W.

- Ap—0 to 8 inches; black (10YR 2/1) silty clay loam (30 percent clay), very dark gray (10YR 3/1) dry; weak medium granular structure; friable; neutral; clear smooth boundary.
- A1—8 to 18 inches; black (10YR 2/1) silty clay loam (30 percent clay), black (10YR 2/1) and very dark grayish brown (10YR 3/2) crushed, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to moderate medium granular; friable; neutral; gradual smooth boundary.
- A2—18 to 25 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silty clay loam (32 percent clay), dark grayish brown (10YR 4/2) dry; weak fine and very fine subangular blocky structure; friable; neutral; gradual smooth boundary.
- BA—25 to 33 inches; very dark grayish brown (10YR 3/2) silty clay loam (32 percent clay), very dark grayish brown (10YR 3/2) rubbed, grayish brown

(10YR 5/2) and dark grayish brown (10YR 4/2) dry; very dark gray (10YR 3/1) and dark gray (10YR 4/1) coatings on faces of peds; weak fine subangular blocky structure parting to moderate very fine subangular blocky; firm; neutral; gradual smooth boundary.

Bw—33 to 43 inches; dark grayish brown (10YR 4/2) silty clay loam (34 percent clay); dark gray (10YR 4/1) organic coatings on faces of peds; common medium distinct brown (10YR 4/3) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; slightly acid; clear smooth boundary.

BC—43 to 47 inches; mottled yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) silty clay loam (37 percent clay); common distinct dark gray (10YR 4/1) coatings on faces of peds; weak medium prismatic structure; firm; slightly acid; clear smooth boundary.

C1—47 to 56 inches; mottled light brownish gray (2.5Y 6/2), strong brown (7.5YR 4/6), and dark grayish brown (10YR 4/2) silty clay loam (35 percent clay); massive; firm; common medium and fine dark concretions of manganese oxide; slightly acid; clear smooth boundary.

C2—56 to 60 inches; gray (5Y 5/1) silty clay loam (35 percent clay); massive; firm; common medium and fine dark concretions of manganese oxide; common large dark red (2.5YR 3/6) concretions of iron oxide; neutral.

The thickness of the solum typically is about 48 inches but ranges from about 40 to 70 inches. The soils have no carbonates within a depth of 5 feet. The mollic epipedon is 20 to 35 inches thick.

The A and Ap horizons have chroma of 1 or 2. The A horizon is typically silty clay loam but in some pedons is silt loam. The BA horizon has chroma of 1 or 2. The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. Mottles, which occur throughout the Bw and BC horizons, have hue of 7.5YR and 10YR, value of 4 or 5, and chroma of 3 to 8. The Bw horizon contains 28 to 35 percent clay. The C horizon is silt loam or silty clay loam.

Gara Series

The Gara series consists of well drained, moderately slowly permeable soils on narrow, convex ridgetops and convex side slopes in the uplands. These soils formed in glacial till. The native vegetation was mixed grasses and trees. Slope ranges from 9 to 25 percent.

Typical pedon of Gara loam, 14 to 18 percent slopes, moderately eroded, in a pasture on an east-facing,

convex side slope; 145 feet east and 2,200 feet north of the southwest corner of sec. 25, T. 70 N., R. 28 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) loam (about 26 percent clay), dark grayish brown (10YR 4/2) dry; mixed with about 20 percent pockets of dark grayish brown (10YR 4/2) subsoil material; weak fine subangular blocky structure parting to weak very fine granular; friable; many fine and medium roots; about 1 percent 5-millimeter pebbles; neutral; clear smooth boundary.

BE—6 to 11 inches; dark grayish brown (10YR 4/2) clay loam (about 31 percent clay), grayish brown (10YR 5/2) dry; mixed with about 30 percent pockets of yellowish brown (10YR 5/4) subsoil material; very dark gray (10YR 3/1) coatings on faces of peds; weak fine subangular blocky structure parting to weak very fine granular; friable; many fine and medium roots; about 1 percent 5-millimeter pebbles; slightly acid; clear smooth boundary.

Bt1—11 to 18 inches; yellowish brown (10YR 5/6) clay loam (about 33 percent clay); dark grayish brown (10YR 4/2) coatings on faces of peds; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure parting to moderate very fine angular blocky; firm; few distinct yellowish brown (10YR 5/4) clay films on faces of peds; common fine roots; few fine dark concretions of manganese oxide; about 1 percent 5-millimeter pebbles; medium acid; clear smooth boundary.

Bt2—18 to 28 inches; yellowish brown (10YR 5/6) clay loam (about 34 percent clay); common fine distinct strong brown (7.5YR 5/8) mottles; weak medium prismatic structure parting to moderate fine angular blocky; firm; few distinct yellowish brown (10YR 5/4) clay films on faces of peds; common fine roots; few fine dark concretions of manganese oxide; about 1 percent 5-millimeter pebbles; slightly acid; gradual smooth boundary.

BC—28 to 36 inches; yellowish brown (10YR 5/6) clay loam (about 33 percent clay); common fine prominent light brownish gray (2.5Y 6/2) and common fine prominent strong brown (7.5YR 5/8) mottles; weak medium prismatic structure parting to weak fine angular blocky; firm; few distinct yellowish brown (10YR 5/4) clay films on vertical faces; few fine roots; common fine dark concretions of manganese oxide; few 5-millimeter pebbles; mildly alkaline; clear smooth boundary.

C1—36 to 48 inches; mottled yellowish brown (10YR 5/6), grayish brown (10YR 5/2), and strong brown (7.5YR 5/8) clay loam (about 32 percent clay); appears massive but has some pressure faces; firm; few fine roots; few dark concretions of

manganese oxide; common fine and medium accumulations of calcium carbonate; about 2 percent 5-millimeter pebbles; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2—48 to 60 inches; yellowish brown (10YR 5/6) clay loam (about 32 percent clay); common fine distinct light brownish gray (10YR 6/2) and few fine distinct strong brown (7.5YR 5/8) mottles; appears massive but has some pressure faces; few fine dark concretions of manganese oxide; common fine and medium accumulations of calcium carbonate; about 3 percent 5-millimeter pebbles; strongly effervescent; moderately alkaline.

The solum typically ranges from 36 to 70 inches in thickness. In eroded areas, however, it may be thinner. The thickness of the solum and the depth to carbonates typically are the same. A few stones and pebbles are throughout the profile.

The A or Ap horizon typically has chroma of 1 or 2. It is loam, silt loam, or clay loam. It is 6 to 9 inches thick. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It ranges from 32 to 35 percent clay. The BC and C horizons typically have value of 4 or 5 and chroma of 4 to 6.

The moderately eroded and severely eroded Gara soils in this county have a thinner dark surface layer than is definitive for the series.

Grundy Series

The Grundy series consists of somewhat poorly drained, slowly permeable soils on convex ridgetops and side slopes in the uplands. These soils formed in loess. The native vegetation was tall prairie grasses. Slope ranges from 2 to 5 percent.

Typical pedon of Grundy silty clay loam, 2 to 5 percent slopes, in a hayfield on an east- to southeast-facing, convex ridgetop; 650 feet west and 400 feet north of the southeast corner of sec. 23, T. 68 N., R. 29 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam (28 percent clay), black (10YR 2/1) crushed, dark gray (10YR 4/1) dry; weak fine granular structure; friable; common fine and medium roots; neutral; clear smooth boundary.

A—10 to 16 inches; black (10YR 2/1) silty clay loam (27 percent clay), very dark brown (10YR 2/2) crushed, dark gray (10YR 4/1) dry; weak fine granular structure; friable; common fine roots; slightly acid; gradual smooth boundary.

BA—16 to 20 inches; dark grayish brown (10YR 4/2)

silty clay loam (29 percent clay), gray (10YR 5/1) dry; very dark gray (10YR 3/1) coatings on faces of peds; few fine faint yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; friable; common very fine roots; slightly acid; clear smooth boundary.

Bt1—20 to 26 inches; dark grayish brown (2.5Y 4/2) silty clay (43 percent clay); very dark gray (10YR 3/1) coatings on faces of peds; few fine faint light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; few distinct dark gray (10YR 4/1) clay films; common fine roots; slightly acid; clear smooth boundary.

Bt2—26 to 37 inches; grayish brown (2.5Y 5/2) silty clay (44 percent clay); dark gray (10YR 4/1) coatings on faces of peds; common fine faint light olive brown (2.5Y 5/4) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; common distinct dark gray (10YR 4/1) clay films; few fine roots; slightly acid; gradual smooth boundary.

Bt3—37 to 45 inches; grayish brown (2.5Y 5/2) silty clay (42 percent clay); dark gray (10YR 4/1) coatings on faces of peds; common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; common distinct gray (10YR 5/1) clay films; few very fine roots; few fine black (N 2/0) concretions of manganese oxide; common fine strong brown (7.5YR 5/6) concretions of iron oxide; neutral; clear smooth boundary.

Bt4—45 to 51 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) silty clay loam (39 percent clay); dark gray (10YR 4/1) coatings on faces of peds; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; common distinct gray (10YR 5/1) clay films; few very fine roots; common medium strong brown (7.5YR 5/8) concretions of iron oxide; few fine black (N 2/0) concretions of manganese oxide; neutral; gradual smooth boundary.

BC—51 to 60 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) silty clay loam (37 percent clay); common medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; firm; common distinct gray (10YR 5/1) clay in pores; common fine black (N 2/0) concretions of manganese oxide; neutral.

The thickness of the solum typically ranges from 40

to about 72 inches. The mantle of loess generally has no free carbonates. The mollic epipedon is 11 to 20 inches thick.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam or silty clay loam. The Bt horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 to 3 in the upper part and hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 1 or 2 in the lower part. Some pedons have a C horizon. This horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2.

Haig Series

The Haig series consists of poorly drained, slowly permeable soils on broad flats in the uplands. These soils formed in loess. The native vegetation was tall prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Haig silty clay loam, 0 to 2 percent slopes, in a cultivated field on a broad, upland flat; 500 feet west and 1,200 feet south of the northeast corner of sec. 21, T. 70 N., R. 29 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam (32 percent clay), black (10YR 2/1) crushed, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; few fine roots; neutral; clear smooth boundary.

A—8 to 19 inches; black (10YR 2/1) silty clay loam (38 percent clay), dark gray (10YR 4/1) dry; few very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; slightly acid; gradual smooth boundary.

Bt—19 to 24 inches; very dark gray (10YR 3/1) silty clay (47 percent clay), gray (10YR 5/1) dry; black (10YR 2/1) coatings on faces of peds; few fine distinct dark yellowish brown (10YR 4/6) mottles; weak medium and fine subangular blocky structure; firm; many distinct clay films on faces of peds; few fine roots; medium acid; gradual smooth boundary.

Btg1—24 to 35 inches; dark gray (10YR 4/1) silty clay (43 percent clay); few very dark gray (10YR 3/1) coatings on faces of peds; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; many distinct clay films on faces of peds; few fine roots; few fine dark concretions of manganese oxide; slightly acid; gradual smooth boundary.

Btg2—35 to 45 inches; light brownish gray (2.5Y 6/2) silty clay (41 percent clay); common medium distinct yellowish brown (10YR 5/8) and common medium distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; firm; many distinct clay films on faces of peds; few fine roots;

few fine dark concretions of manganese oxide; slightly acid; gradual smooth boundary.

BCg—45 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam (36 percent clay); common medium and coarse prominent strong brown (7.5YR 5/8) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; common distinct clay films on faces of peds; few fine dark concretions of manganese oxide; neutral.

The solum ranges from 52 to 72 inches in thickness. The thickness of the mollic epipedon ranges from 20 to 24 inches.

The A horizon has value of 2 or 3 and chroma of 0 or 1. It is silt loam or silty clay loam. The Btg horizon has hue of 10YR to 5Y.

Humeston Series

The Humeston series consists of poorly drained, very slowly permeable soils on low, slightly concave foot slopes and alluvial fans on bottom land. These soils formed in alluvium. The native vegetation was tall prairie grasses. Slope ranges from 0 to 5 percent.

Typical pedon of Humeston silty clay loam, 0 to 2 percent slopes, in a cultivated field on bottom land; 1,590 feet east and 2,380 feet north of the southwest corner of sec. 5, T. 69 N., R. 30 W.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silty clay loam (about 29 percent clay), gray (10YR 5/1) dry; weak coarse subangular blocky structure parting to moderate fine and medium subangular blocky; friable; neutral; abrupt smooth boundary.

E1—11 to 19 inches; dark gray (10YR 4/1) silt loam (about 25 percent clay), gray (10YR 5/1) dry; few fine very dark gray (10YR 3/1) coatings on faces of peds; few fine faint dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure parting to weak thin platy; friable; light gray (10YR 6/1 dry) silt coatings on faces of peds; medium acid; clear smooth boundary.

E2—19 to 25 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silt loam (about 26 percent clay), gray (10YR 5/1) dry; few fine faint dark yellowish brown (10YR 4/6) mottles; weak medium and fine subangular blocky structure parting to moderate thin platy; friable; light gray (10YR 6/1 dry) silt coatings on faces of peds; strongly acid; clear smooth boundary.

BE—25 to 32 inches; dark gray (10YR 4/1) and gray (10YR 5/1) silty clay loam (about 34 percent clay); few fine faint dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure

parting to moderate fine subangular blocky; friable; light gray (10YR 6/1 dry) silt coatings on faces of peds; strongly acid; clear smooth boundary.

Bt1—32 to 45 inches; very dark gray (10YR 3/1) silty clay (about 44 percent clay); few fine faint dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure parting to moderate medium and fine subangular blocky; firm; many faint clay films on faces of peds; medium acid; gradual smooth boundary.

Bt2—45 to 60 inches; very dark gray (10YR 3/1) silty clay (about 46 percent clay); few fine faint dark yellowish brown (10YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; firm; many faint clay films on faces of peds; slightly acid.

The solum typically is 48 to more than 60 inches thick. The soils have no carbonates within a depth of 6 feet. The mollic epipedon is 10 to 16 inches thick.

The A1 and Ap horizons have value of 2 or 3. They are silt loam or silty clay loam. The E horizon has value of 4 or 5. The Bt horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is silty clay loam or silty clay. It has a maximum clay content of 35 to 48 percent. Some pedons have a BC horizon, which has value of 2 to 4.

Kennebec Series

The Kennebec series consists of moderately well drained, moderately permeable soils on bottom land. These soils formed in silty alluvium. The native vegetation was tall prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Kennebec silt loam, 0 to 2 percent slopes, in a pasture; 105 feet west and 1,560 feet south of the northeast corner of sec. 3, T. 70 N., R. 30 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silt loam (26 percent clay), dark gray (10YR 4/1) and grayish brown (10YR 5/2) dry, very dark gray (10YR 3/1) rubbed; moderate very fine subangular blocky structure; friable; many fine and medium roots; medium acid; clear smooth boundary.

A1—7 to 15 inches; black (10YR 2/1) and very dark grayish brown (10YR 3/2) silt loam (26 percent clay), very dark gray (10YR 3/1) and dark gray (10YR 4/1) dry, very dark brown (10YR 2/2) rubbed; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; medium acid; gradual smooth boundary.

A2—15 to 25 inches; black (10YR 2/1) and very dark

brown (10YR 2/2) silt loam (25 percent clay), dark gray (10YR 4/1) and very dark gray (10YR 3/1) dry, very dark brown (10YR 2/2) rubbed; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; few fine roots; medium acid; gradual smooth boundary.

A3—25 to 33 inches; black (10YR 2/1) and very dark grayish brown (10YR 3/2) silt loam (25 percent clay) very dark gray (10YR 3/1) and dark gray (10YR 4/1) dry, very dark gray (10YR 3/1) rubbed; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; few fine roots; medium acid; gradual smooth boundary.

A4—33 to 40 inches; very dark gray (10YR 3/1) and black (10YR 2/1) silt loam (26 percent clay), dark gray (10YR 4/1) and very dark gray (10YR 3/1) dry; few medium faint very dark grayish brown (10YR 3/2) mottles; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; light gray (10YR 7/1 dry) sand grains; few fine roots; medium acid; gradual smooth boundary.

AC—40 to 47 inches; very dark gray (10YR 3/1) silt loam (25 percent clay); few medium faint dark grayish brown (2.5Y 4/2) mottles; weak fine subangular blocky structure; friable; light gray (10YR 7/1 dry) silt coatings and light gray (10YR 7/1 dry) sand grains on faces of peds; few fine roots; slightly acid; gradual smooth boundary.

C—47 to 60 inches; dark gray (10YR 4/1) silt loam (27 percent clay); few medium faint brown (10YR 4/3) mottles; weak fine prismatic structure; friable; light gray (10YR 7/1 dry) silt coatings and light gray (10YR 7/1 dry) sand grains on faces of peds; slightly acid.

The solum and the mollic epipedon typically are more than 3 feet thick. They include the AC horizon. The soils have no carbonates throughout the solum and typically none within a depth of 5 feet.

The A and Ap horizons have chroma of 1 or 2. Overwash phases, if they occur, have hue of 10YR, value of 3 or 4, and chroma of 2. In some pedons value increases below a depth of 20 inches. The C horizon typically has hue of 10YR, but in some pedons it has hue of 2.5Y. It has clay fillings or fine faint mottles that have hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 8.

Keswick Series

The Keswick series consists of moderately well drained, slowly permeable soils on narrow, convex ridgetops, on short, convex shoulder slopes, and on side slopes in the uplands. These soils formed in loess

or in erosional sediments over a red, clayey paleosol that weathered from glacial till. The native vegetation was deciduous trees. Slope ranges from 5 to 14 percent.

Typical pedon of Keswick silt loam, 5 to 9 percent slopes, in a grassy area surrounded by trees on a north-facing, convex side slope of a narrow interfluvium; 1,550 feet west and 2,470 feet north of the southeast corner of sec. 21, T. 67 N., R. 29 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam (about 26 percent clay and 10 percent sand), dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry, very dark grayish brown (10YR 3/2) rubbed; weak very fine subangular blocky structure; friable; common fine roots; neutral; clear smooth boundary.

E—3 to 9 inches; brown (10YR 5/3) silt loam (about 24 percent clay and 15 percent sand), light yellowish brown (10YR 6/4) dry; mixed with about 5 percent pockets of brown (7.5YR 5/4) subsoil material; dark grayish brown (10YR 4/2) coatings on faces of peds; weak medium platy structure parting to weak very fine subangular blocky; friable; few fine roots; medium acid; clear smooth boundary.

BE—9 to 17 inches; brown (7.5YR 5/4) clay loam (about 30 percent clay and 28 percent sand); grayish brown (10YR 5/2) coatings on faces of peds; weak medium subangular blocky structure parting to moderate very fine angular blocky; friable; light gray (10YR 7/2 dry) silt coatings on faces of peds; few fine roots; strongly acid; clear smooth boundary.

2Bt1—17 to 24 inches; reddish brown (5YR 5/4 and 2.5YR 4/4) clay (about 44 percent clay); few fine prominent grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure parting to moderate very fine angular blocky; firm; common prominent brown (7.5YR 5/2) clay films on faces of peds; few fine roots; about 3 percent 1-millimeter pebbles; strongly acid; gradual smooth boundary.

2Bt2—24 to 32 inches; strong brown (7.5YR 5/6) and reddish brown (2.5YR 4/4) clay loam (about 39 percent clay); few fine prominent grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure parting to moderate fine subangular blocky; firm; common distinct brown (7.5YR 5/4) clay films on faces of peds; few fine roots; about 4 percent 1-millimeter pebbles; strongly acid; gradual smooth boundary.

2Bt3—32 to 42 inches; strong brown (7.5YR 5/6) clay loam (about 35 percent clay); common fine faint strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; firm; few distinct brown

(7.5YR 5/4) clay films on faces of peds; few fine roots; about 5 percent 1-millimeter pebbles; medium acid; gradual smooth boundary.

2BC—42 to 60 inches; mottled yellowish brown (10YR 5/6), light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) clay loam (about 30 percent clay); weak medium prismatic structure parting to weak medium subangular blocky; firm; few brown (7.5YR 5/4) clay flows in some root channels; many dark concretions of manganese oxide; about 5 percent 1-millimeter pebbles; neutral.

The thickness of the solum and the depth to carbonates range from 42 to 75 inches. A few stones and pebbles are throughout the profile.

The A or Ap horizon has value of 3 or 4 and chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 2 or 3. It is 6 to 10 inches thick. The A and E horizons are loam or silt loam. The 2BC horizon has hue of 10YR, 7.5YR, 2.5Y, or 5Y and chroma of 1 to 6. Depth to the Bt horizon ranges from 8 to 17 inches. The maximum clay content is at a depth of 10 to 20 inches.

Ladoga Series

The Ladoga series consists of moderately well drained, moderately slowly permeable soils on ridgetops and side slopes in the uplands and on high stream benches. These soils formed in loess. The native vegetation was mixed grasses and trees. Slope ranges from 5 to 14 percent.

Typical pedon of Ladoga silt loam, 5 to 9 percent slopes, in a pasture on a north- to northwest-facing, convex ridgetop; 2,340 feet east and 2,340 feet south of the northwest corner of sec. 6, T. 70 N., R. 31 W.

A—0 to 8 inches; very dark gray (10YR 3/1) silt loam (about 26 percent clay), dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to moderate fine granular; friable; many very fine roots; slightly acid; clear smooth boundary.

E—8 to 12 inches; dark grayish brown (10YR 4/2) silt loam (about 26 percent clay), light brownish gray (10YR 6/2) dry, dark grayish brown (10YR 4/2) kneaded; very dark gray (10YR 3/1) coatings on faces of peds; weak thin platy structure parting to moderate very fine subangular blocky; friable; common very fine roots; slightly acid; clear smooth boundary.

Bt1—12 to 16 inches; brown (10YR 4/3) silty clay loam (about 39 percent clay); few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to moderate fine subangular and angular blocky; friable; few distinct

dark grayish brown (10YR 4/2) clay films and light brownish gray (10YR 6/2 dry) silt coatings on faces of peds; common very fine roots; medium acid; gradual smooth boundary.

Bt2—16 to 23 inches; brown (10YR 5/3) silty clay (about 41 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to moderate fine subangular and angular blocky; firm; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

Bt3—23 to 32 inches; mottled yellowish brown (10YR 5/6), grayish brown (2.5Y 5/2), and strong brown (7.5YR 5/6) silty clay loam (about 39 percent clay); weak coarse subangular blocky structure parting to weak medium and fine subangular and angular blocky; firm; few prominent dark grayish brown (10YR 4/2) clay films on faces of peds; few very fine roots; few dark concretions of manganese oxide; medium acid; gradual smooth boundary.

BC—32 to 42 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/8) silty clay loam (about 33 percent clay); weak coarse prismatic structure parting to weak medium and fine subangular blocky; friable; few distinct dark grayish brown (10YR 4/2) and brown (10YR 4/3) clay films on faces of peds; black (10YR 2/1) and very dark gray (10YR 3/1) clay in root channels; common very dark gray (N 3/0) and black (10YR 2/1) concretions of manganese oxide; slightly acid; gradual smooth boundary.

C1—42 to 48 inches; mottled light brownish gray (2.5Y 6/2), strong brown (7.5YR 5/6), and yellowish brown (10YR 5/8) silty clay loam (about 30 percent clay); appears massive but has some horizontal cleavage planes; friable; common dark brown (7.5YR 3/2) concretions of iron and manganese oxides; neutral; gradual smooth boundary.

C2—48 to 60 inches; mottled light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) silty clay loam (about 29 percent clay); massive; few dark brown (7.5YR 3/2) concretions of iron oxide; neutral.

The thickness of the solum ranges from 36 to 72 inches. By weighted average, the content of clay in the control section is generally about 40 percent but ranges from 38 to 42 percent. The upper part of the C horizon has no carbonates.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is 6 to 9 inches thick. The Ap horizon is dominantly silt loam but is silty clay loam in eroded areas. The E horizon has value of 4 or 5. It is 0 to 5 inches thick. The

Bt horizon typically has a few grayish brown or olive brown mottles in the lower part.

The moderately eroded Ladoga soils in this county have a thinner dark surface layer than is definitive for the series.

Lamoni Series

The Lamoni series consists of somewhat poorly drained, slowly permeable soils on short, convex side slopes and narrow ridges above the head of drainageways in the uplands. These soils formed in a truncated, gray, clayey paleosol that weathered from glacial till. The native vegetation was tall prairie grasses. Slope ranges from 5 to 14 percent.

Typical pedon of Lamoni silty clay loam, 5 to 9 percent slopes, in a cultivated field on a southeast-facing, convex side slope; 2,430 feet west and 1,730 feet south of the northeast corner of sec. 34, T. 70 N., R. 28 W.

Ap—0 to 11 inches; black (10YR 2/1) silty clay loam (34 percent clay), very dark gray (10YR 3/1) and dark gray (10YR 4/1) dry; moderate fine subangular blocky and granular structure; friable; many very fine roots; medium acid; abrupt smooth boundary.

2Bt1—11 to 16 inches; dark grayish brown (10YR 4/2) clay (51 percent clay); very dark grayish brown (10YR 3/2) coatings on faces of peds; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure parting to moderate very fine subangular blocky; firm; common distinct dark gray (10YR 4/1) clay films on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

2Bt2—16 to 23 inches; grayish brown (2.5Y 5/2) clay (49 percent clay); very dark gray (10YR 3/1) coatings in root channels; common fine distinct yellowish brown (10YR 5/6) and few fine distinct strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure parting to moderate very fine subangular blocky; firm; many distinct dark gray (10YR 4/1) clay films on faces of peds; few very fine roots; medium acid; gradual smooth boundary.

2Bt3—23 to 33 inches; light gray (5Y 6/1) clay (43 percent clay); common fine distinct olive yellow (5Y 6/6) and common fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; common prominent gray (10YR 5/1) clay films on faces of peds; very few very fine roots; few fine dark concretions of manganese oxide;

medium acid; gradual smooth boundary.

2Bt4—33 to 42 inches; mottled yellowish brown (10YR 5/6) and light gray (5Y 6/1) clay loam (39 percent clay); weak medium prismatic structure parting to moderate medium subangular blocky; firm; few distinct gray (10YR 5/1) clay films on faces of peds; very few very fine roots; common fine dark concretions of manganese oxide; slightly acid; gradual smooth boundary.

2Bt5—42 to 54 inches; light gray (5Y 6/1) clay loam (32 percent clay); many medium prominent yellowish brown (10YR 5/6) olive yellow (2.5Y 6/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; very few distinct gray (10YR 5/1) clay films on faces of peds; few fine and medium dark concretions of manganese oxide; neutral; gradual smooth boundary.

2BC—54 to 60 inches; mottled yellowish brown (10YR 5/8), light gray (5Y 6/1), and strong brown (7.5YR 5/8) clay loam (32 percent clay); weak medium prismatic structure parting to moderate medium and fine subangular blocky; firm; very few distinct gray (10YR 5/1) clay films on faces of peds; few medium dark concretions of manganese oxide; common fine accumulations of calcium carbonate; about 1 percent 5-millimeter pebbles; slightly effervescent; mildly alkaline.

The thickness of the solum typically is 40 to 60 inches. The soils have no carbonates within a depth of 50 inches. A few stones and pebbles are throughout the profile.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. It typically is silty clay loam but in some pedons is loam or silt loam. It is 10 to 14 inches thick. The 2Bt horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 6. The color and texture of this horizon vary and are related mainly to the remaining amount of truncated paleosol. The part of the Bt horizon that is clay typically is 10 to 24 inches thick. In the most clayey part of this horizon, the content of clay ranges from 40 to 50 percent. The content of sand ranges from 15 to 30 percent in the upper part of the solum and from 30 to 45 percent in the C horizon.

The moderately eroded Lamoni soils in this county do not have a mollic epipedon, which is definitive for the series.

Lindley Series

The Lindley series consists of well drained, moderately slowly permeable soils on convex, narrow ridges and convex or plane valley side slopes in the uplands. These soils formed in glacial till. The native

vegetation was deciduous trees. Slope ranges from 9 to 40 percent.

Typical pedon of Lindley loam, 18 to 40 percent slopes, in a wooded area on a northwest-facing, convex side slope; 1,840 feet west and 2,240 feet north of the southeast corner of sec. 21, T. 67 N., R. 29 W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) loam (about 25 percent clay), dark gray (10YR 4/1) and gray (10YR 5/1) dry, very dark grayish brown (10YR 3/2) rubbed; weak medium granular structure; friable; common medium and fine roots; medium acid; abrupt smooth boundary.

E1—2 to 5 inches; dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) loam (about 20 percent clay), light gray (10YR 7/2) dry; weak medium platy structure parting to weak very fine subangular blocky; friable; common medium and fine roots; very strongly acid; clear smooth boundary.

E2—5 to 10 inches; grayish brown (10YR 5/2) and brown (10YR 5/3) loam (about 20 percent clay), light gray (10YR 7/2) dry; weak medium platy structure parting to weak very fine subangular blocky; friable; common medium and fine roots; about 2 percent 5-millimeter pebbles; strongly acid; clear smooth boundary.

Bt1—10 to 16 inches; yellowish brown (10YR 5/4) clay loam (about 33 percent clay); weak medium subangular blocky structure parting to weak very fine angular blocky; friable; few distinct grayish brown (10YR 5/2) clay films and light gray (10YR 7/2 dry) silt coatings on faces of peds; common medium and fine roots; about 1 percent 5-millimeter pebbles; strongly acid; clear smooth boundary.

Bt2—16 to 27 inches; yellowish brown (10YR 5/6) clay loam (about 36 percent clay); few fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure parting to weak fine subangular blocky; firm; common distinct yellowish brown (10YR 5/4) clay films on faces of peds; few fine roots; about 4 percent 5-millimeter pebbles; strongly acid; gradual smooth boundary.

Bt3—27 to 38 inches; yellowish brown (10YR 5/6) clay loam (about 35 percent clay); weak medium subangular blocky structure; firm; few distinct yellowish brown (10YR 5/4) clay films on faces of peds; few fine roots; about 4 percent 5-millimeter pebbles; strongly acid; clear smooth boundary.

C—38 to 60 inches; yellowish brown (10YR 5/6) clay loam (about 25 percent clay); common fine and medium distinct gray (10YR 6/1) and few fine faint strong brown (7.5YR 5/8) mottles; massive; firm; very few fine roots; common fine accumulations of calcium carbonate; about 4 percent 5-millimeter

pebbles; slightly effervescent; mildly alkaline.

The thickness of the solum and the depth to carbonates range from 30 to 50 inches. A few stones and pebbles are throughout the profile.

The A horizon has value of 3 or 4 and chroma of 1 or 2. The Ap horizon is loam or clay loam. The E horizon has value of 4 to 6 and chroma of 2 to 4. It is 2 to 10 inches thick. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is typically clay loam or loam. The C horizon has hue of 10YR or 7.5YR and chroma of 4 to 6.

Lineville Series

The Lineville series consists of somewhat poorly drained, slowly permeable soils on slightly low, narrow, convex ridges in the uplands. These soils formed in loess and pediments over a red, clayey paleosol. The native vegetation was mixed trees and grasses. Slope ranges from 5 to 9 percent.

Typical pedon of Lineville silt loam, 5 to 9 percent slopes, in a pasture on a southeast-facing, slightly low, narrow interfluvium; 1,000 feet east and 930 feet south of the northwest corner of sec. 15, T. 70 N., R. 28 W.

A—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam (27 percent clay), grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many very fine roots; medium acid; clear smooth boundary.

E—7 to 11 inches; dark grayish brown (10YR 4/2) silt loam (26 percent clay), grayish brown (10YR 5/2) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak thin platy structure; friable; few very fine roots; slightly acid; clear smooth boundary.

Bt1—11 to 19 inches; dark brown (10YR 4/3) and dark yellowish brown (10YR 4/4) silty clay loam (31 percent clay); few distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium subangular blocky structure parting to moderate fine angular and subangular blocky; friable; thin discontinuous dark brown (10YR 3/3) clay films and light gray (10YR 7/1 dry) silt coatings on faces of peds; few very fine roots; strongly acid; clear smooth boundary.

2Bt2—19 to 25 inches; brown (10YR 4/3) loam (23 percent clay and 21 percent sand); few fine faint yellowish brown (10YR 5/4), grayish brown (10YR 5/2), and dark brown (10YR 3/3) mottles; moderate fine subangular blocky structure; friable; few distinct dark grayish brown (10YR 4/2) clay films and light gray (10YR 7/1 dry) silt coatings on faces of peds;

common very fine and fine roots; few very fine dark concretions of manganese oxide; medium acid; clear smooth boundary.

2Bt3—25 to 33 inches; yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) loam (19 percent clay and 28 percent sand); few fine distinct strong brown (7.5YR 5/8) and few fine faint brown (10YR 5/3) mottles; weak medium prismatic structure parting to weak fine subangular blocky; friable; few distinct dark yellowish brown (10YR 4/4) clay films and light gray (10YR 7/1 dry) silt coatings on faces of peds; very few fine roots; few very fine dark concretions of manganese oxide; medium acid; clear smooth boundary.

2Bt4—33 to 46 inches; yellowish brown (10YR 5/4) loam (26 percent clay and 31 percent sand); few fine distinct strong brown (7.5YR 5/6) and few fine faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few distinct dark yellowish brown (10YR 4/4) clay films and light gray (10YR 7/1) silt coatings on faces of peds; very few fine roots; few very fine dark concretions of manganese oxide; slightly acid; clear smooth boundary.

3Bt5—46 to 54 inches; strong brown (7.5YR 5/6) clay loam (37 percent clay and 37 percent sand); common fine faint brown (7.5YR 5/2) and strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct dark brown (7.5YR 4/4) clay films on faces of peds; few fine dark concretions of manganese oxide; about 2 percent 5-millimeter pebbles; neutral; gradual smooth boundary.

3Bt6—54 to 60 inches; mottled strong brown (7.5YR 5/6) and brown (7.5YR 5/2) clay (47 percent clay and 29 percent sand); weak coarse prismatic structure parting to weak medium subangular blocky; firm; few distinct brown (7.5YR 4/4) clay films on faces of peds; about 2 percent 5-millimeter pebbles; neutral.

The solum is about 60 or more inches thick. The soils have no carbonates within a depth of 6 feet. A few stones and pebbles are throughout the profile.

The A or Ap horizon has value of 2 or 3. It is 6 to 9 inches thick. The E horizon has value of 4 or 5. It is silt loam or loam. It is 0 to 6 inches thick. The 2Bt horizon has hue of 10YR or 7.5YR and chroma of 2 to 4. It has mottles with higher chroma. It is loam or clay loam. The 3Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6.

The moderately eroded Lineville soils in this county have a thinner dark surface layer than is definitive for the series.

Macksburg Series

The Macksburg series consists of somewhat poorly drained, moderately slowly permeable soils on convex ridgetops and side slopes in the uplands. These soils formed in loess. The native vegetation was tall prairie grasses. Slope ranges from 1 to 5 percent.

Typical pedon of Macksburg silty clay loam, 1 to 5 percent slopes, in a cultivated field on a nearly flat to convex ridgetop; 1,380 feet west and 500 feet north of the southeast corner of sec. 31, T. 70 N., R. 31 W.

- Ap—0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silty clay loam (about 33 percent clay), gray (10YR 5/1) and grayish brown (10YR 5/2) dry, very dark grayish brown (10YR 3/2) rubbed; weak very fine subangular blocky structure; friable; common fine roots; medium acid; abrupt smooth boundary.
- A1—7 to 12 inches; very dark gray (10YR 3/1) silty clay loam (about 34 percent clay) gray (10YR 5/1) and grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; common fine roots; medium acid; clear smooth boundary.
- A2—12 to 18 inches; very dark grayish brown (10YR 3/2) silty clay loam (about 39 percent clay); mixed with some brown (10YR 4/3) material; very dark gray (10YR 3/1) coatings on faces of peds; weak medium subangular blocky structure parting to weak fine subangular blocky; firm; few fine roots; strongly acid; clear smooth boundary.
- Bt1—18 to 27 inches; brown (10YR 5/3 and 4/3) silty clay loam (about 39 percent clay); few fine faint yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure parting to weak fine subangular blocky; firm; few faint grayish brown (10YR 5/2) clay films on faces of peds; medium acid; gradual smooth boundary.
- Bt2—27 to 37 inches; grayish brown (2.5Y 5/2) silty clay loam (about 36 percent clay); common fine faint light olive brown (2.5Y 5/4) and common fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few fine dark concretions of manganese oxide; medium acid; gradual smooth boundary.
- Bt3—37 to 51 inches; grayish brown (2.5Y 5/2) silty clay

loam (about 32 percent clay); common fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few distinct grayish brown (10YR 5/2) clay films on faces of peds; common fine dark concretions of manganese oxide; medium acid; gradual smooth boundary.

BC—51 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam (about 29 percent clay); common fine prominent yellowish brown (10YR 5/6 and 5/8) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; common dark concretions of manganese oxide; slightly acid.

The thickness of the solum ranges from 48 to more than 60 inches. The soils have no carbonates within a depth of 6 feet.

The A and Ap horizons have value of 2 or 3. They are 16 to 22 inches thick. They are dominantly silty clay loam, but in some pedons they are silt loam. The Bt horizon has chroma of 2 to 4 in the upper part and generally has value of 5 or 6 and chroma of 2 to 4 in the lower part. It is mainly silty clay loam but in some pedons is silty clay. The content of clay ranges from 36 to 42 percent in the upper part of this horizon and from 30 to 36 percent in the lower part.

Mystic Series

The Mystic series consists of somewhat poorly drained, slowly permeable soils on narrow ridges, convex side slopes, and concave foot slopes in the uplands and on narrow ridges and the upper parts of escarpments on high stream terraces. These soils formed in clayey ancient alluvium. The native vegetation was mixed grasses and trees. Slope ranges from 5 to 18 percent.

Typical pedon of Mystic clay loam, 9 to 14 percent slopes, moderately eroded, in a hayfield on a southeast-facing, convex side slope; 900 feet west and 650 feet north of the southeast corner of sec. 2, T. 70 N., R. 28 W.

- Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) clay loam (about 32 percent clay and 25 percent sand), grayish brown (10YR 5/2) dry; mixed with about 20 percent streaks and pockets of brown (10YR 4/3) subsoil material; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) coatings on faces of peds; moderate fine subangular and angular blocky structure; friable; few fine roots; slightly acid; abrupt smooth boundary.
- Bt1—6 to 11 inches; brown (10YR 4/3) clay (about 43 percent clay and 30 percent sand); common

medium and coarse prominent yellowish red (5YR 5/6) and few fine faint dark yellowish brown (10YR 5/6) mottles; moderate fine angular and subangular blocky structures; firm; many distinct brown (10YR 4/3) and dark grayish brown (10YR 4/2) clay films on faces of peds; few very fine roots; about 5 percent 5- to 8-millimeter pebbles; medium acid; gradual smooth boundary.

Bt2—11 to 18 inches; mottled strong brown (7.5YR 5/6), dark yellowish brown (10YR 4/6), grayish brown (10YR 5/2), and brown (10YR 4/3) clay (about 43 percent clay and 30 percent sand); weak medium subangular blocky structure parting to moderate fine subangular blocky; firm; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; very few very fine roots; strongly acid; clear smooth boundary.

Bt3—18 to 25 inches; mottled strong brown (7.5YR 5/6), dark yellowish brown (10YR 4/6), and grayish brown (10YR 5/2) clay loam (about 38 percent clay and 38 percent sand); weak medium subangular blocky structure parting to moderate fine subangular and angular blocky; firm; common distinct grayish brown (10YR 5/2) clay films on faces of peds; very few very fine roots; 2 to 5 percent 5-millimeter pebbles; strongly acid; gradual smooth boundary.

Bt4—25 to 33 inches; mottled strong brown (7.5YR 5/6), light gray (10YR 6/1), and yellowish red (5YR 4/6) clay loam (about 32 percent clay and 38 percent sand); weak medium subangular and angular blocky structure; friable; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; very few very fine roots; strongly acid; gradual smooth boundary.

Bt5—33 to 42 inches; mottled strong brown (7.5YR 5/6) yellowish red (5YR 4/6), light brownish gray (10YR 6/2), and light gray (10YR 6/1) sandy clay loam (about 32 percent clay and 46 percent sand); weak medium subangular blocky structure; friable; few distinct brown (10YR 4/3) clay films on faces of peds; very few very fine roots; medium acid; clear smooth boundary.

BC—42 to 53 inches; mottled strong brown (7.5YR 5/6), grayish brown (10YR 5/2), and light gray (10YR 6/1) clay loam (about 32 percent clay and 35 percent sand); moderate medium angular blocky structure; friable; few distinct brown (10YR 4/3) clay films on faces of peds; medium acid; gradual smooth boundary.

C—53 to 60 inches; strong brown (7.5YR 5/6) clay loam (about 32 percent clay and 33 percent sand); few medium distinct grayish brown (10YR 5/2) mottles;

appears massive but has some vertical cleavage planes; friable; few distinct coatings on vertical cleavage planes; medium acid.

The solum commonly ranges from 48 to 72 inches in thickness. The Ap horizon has chroma of 1 or 2. It is 6 to 9 inches thick. It is dominantly clay loam or loam but ranges to silt loam. Some pedons have an E horizon. This horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam or loam. The Bt horizon generally has hue of 2.5YR to 2.5Y, value of 3 to 5, and chroma of 2 to 6. At least part of this horizon, however, has hue of 7.5YR or redder in the matrix or has many distinct or prominent mottles. Chroma of 1 and value of 4 or 5 are within the range where the horizon has many distinct reddish and yellowish brown mottles with hue of 7.5YR or redder. The texture of the Bt horizon varies over short distances. By weighted average, the content of clay in this horizon ranges from 35 to 48 percent.

The moderately eroded Mystic soils in this county have a thinner dark surface layer than is definitive for the series.

Nevin Series

The Nevin series consists of somewhat poorly drained, moderately permeable soils on low stream terraces. These soils formed in silty alluvium. The native vegetation was tall prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Nevin silty clay loam, 0 to 2 percent slopes, in a cultivated field on a low stream terrace; 1,990 feet west and 131 feet north of the southeast corner of sec. 35, T. 68 N., R. 31 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam (about 29 percent clay), very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure parting to weak fine granular; friable; many fine roots; neutral; abrupt smooth boundary.

A—7 to 13 inches; very dark gray (10YR 3/1) silty clay loam (about 29 percent clay), dark grayish brown (10YR 4/2) dry, very dark gray (10YR 3/1) crushed; black (10YR 2/1) coatings on faces of peds; weak coarse subangular blocky structure parting to weak fine and medium subangular blocky; friable; common fine roots; neutral; clear smooth boundary.

AB—13 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam (about 33 percent clay), dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) crushed; very dark gray (10YR 3/1) coatings on faces of peds; few fine distinct dark

grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure parting to moderate fine subangular blocky; few fine roots; few fine brown (10YR 4/3) accumulations of iron oxide; slightly acid; clear smooth boundary.

Bt1—19 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay loam (about 35 percent clay); weak medium subangular blocky structure parting to moderate fine subangular blocky; very dark gray (10YR 3/1) clay films on faces of peds; friable; few fine roots; few fine brown (10YR 4/3) accumulations of iron oxide; slightly acid; clear smooth boundary.

Bt2—24 to 31 inches; dark grayish brown (2.5Y 4/2) silty clay loam (about 35 percent clay); many fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; friable; very dark grayish brown (10YR 3/2) clay films on faces of peds; few fine roots; few fine yellowish red (5YR 4/6) concretions of iron oxide; neutral; clear smooth boundary.

Bt3—31 to 40 inches; mottled grayish brown (2.5Y 5/2) and gray (10YR 5/1) silty clay loam (about 34 percent clay); weak medium prismatic structure parting to moderate medium subangular blocky; friable; dark gray (10YR 4/1) clay films on faces of peds; few very fine roots; few fine strong brown (7.5YR 4/6) concretions of iron oxide; neutral; gradual smooth boundary.

BC—40 to 50 inches; gray (10YR 5/1) silty clay loam (about 31 percent clay); many fine distinct yellowish brown (10YR 5/6) mottles; dark gray (10YR 4/1) coatings on faces of peds and filled root channels; weak medium prismatic structure; friable; few very fine roots; few fine strong brown (7.5YR 5/6) iron oxide accumulations; few fine very dark gray (10YR 3/1) concretions of manganese oxide; neutral; gradual smooth boundary.

C—50 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam (about 31 percent clay); many medium prominent strong brown (7.5YR 4/6 and 5/6) mottles; massive; friable; common fine very dark gray (N 3/0) concretions of manganese oxide; neutral.

The thickness of the solum typically is more than 40 inches but ranges from 36 to 60 inches. The soils have no free carbonates within a depth of 60 inches. The solum contains 5 to 15 percent sand.

The A horizon has chroma of 1 or 2. It is silt loam or silty clay loam. The content of clay in this horizon is about 26 to 29 percent. The Bt horizon has chroma of 2 to 6. It is silty clay loam in which the content of clay ranges from 32 to 38 percent.

Nira Series

The Nira series consists of moderately well drained, moderately permeable soils on convex, narrow ridges and side slopes in the uplands. These soils formed in deoxidized and leached loess. The native vegetation was tall prairie grasses. Slope ranges from 5 to 14 percent.

Typical pedon of Nira silty clay loam, 5 to 9 percent slopes, in a cultivated field on a north-facing, convex, narrow ridgetop; 1,700 feet west and 500 feet north of the southeast corner of sec. 6, T. 70 N., R. 30 W.

Ap—0 to 11 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silty clay loam (about 31 percent clay), dark grayish brown (10YR 4/2) and brown (10YR 5/3) dry, very dark gray (10YR 3/1) rubbed; weak very fine granular structure; friable; few very fine and fine roots; slightly acid; abrupt smooth boundary.

BA—11 to 15 inches; dark brown (10YR 4/3) silty clay loam (about 34 percent clay); very dark gray (10YR 3/1) organic coatings on faces of peds; weak very fine subangular blocky structure parting to moderate fine granular; friable; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; few very fine and fine roots; medium acid; clear smooth boundary.

Bt—15 to 22 inches; dark brown (10YR 4/3) and dark yellowish brown (10YR 4/4) silty clay loam (about 39 percent clay); few fine faint yellowish brown (10YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; weak very fine subangular blocky structure parting to weak fine granular; firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few fine roots; strongly acid; clear smooth boundary.

Bw1—22 to 29 inches; grayish brown (2.5Y 5/2) silty clay loam (about 37 percent clay); common fine prominent strong brown (7.5YR 4/6) and few fine prominent yellowish red (5YR 4/6) mottles; moderate fine subangular blocky structure parting to moderate very fine subangular blocky; firm; common distinct gray (10YR 5/1) and dark grayish brown (10YR 4/2) clay films on faces of peds; few fine roots; few fine and medium dark concretions of manganese oxide; medium acid; clear smooth boundary.

Bw2—29 to 35 inches; light brownish gray (2.5Y 6/2) silty clay loam (about 35 percent clay); common medium prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8) mottles; weak fine prismatic structure parting to moderate fine and very fine subangular blocky; firm; many distinct gray

(10YR 5/1) coatings on faces of peds; few fine and medium roots; few fine and medium dark concretions of manganese oxide; medium acid; gradual smooth boundary.

Bw3—35 to 46 inches; light brownish gray (2.5Y 6/2) silty clay loam (about 34 percent clay); common medium prominent strong brown (7.5YR 5/8) and common medium and coarse prominent yellowish red (5YR 4/8) mottles; weak fine prismatic structure parting to weak fine subangular blocky; firm; many distinct gray (10YR 5/1) coatings on faces of peds; very few fine roots; common fine and medium dark concretions of manganese oxide; medium acid; gradual smooth boundary.

BC—46 to 50 inches; light brownish gray (2.5Y 6/2) silty clay loam (about 32 percent clay); common medium prominent strong brown (7.5YR 4/6) and common medium distinct strong brown (7.5YR 5/6) mottles; weak medium and coarse prismatic structure; firm; common distinct gray (10YR 5/1) coatings on faces of peds; few fine and medium dark concretions of manganese oxide; slightly acid; gradual smooth boundary.

C—50 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam (about 32 percent clay); common medium and coarse prominent strong brown (7.5YR 4/6) and common medium distinct strong brown (7.5YR 5/6) mottles; massive; friable; few fine dark concretions of manganese oxide; slightly acid.

The solum typically ranges from 36 to 50 inches in thickness, but it is as thin as 30 inches on some of the steeper slopes. The soils have no carbonates in the solum and typically have none throughout the C horizon.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. It generally is 10 to 15 inches thick but is thinner in eroded areas. The upper part of the B horizon has value of 3 to 5 and chroma of 3 or 4. Gray mottles are relict. The lower part of the Bw horizon has hue of 2.5Y or 5Y and chroma of 1 or 2. The B horizon is silty clay loam in which the content of clay ranges from 33 to 38 percent.

The moderately eroded Nira soils do not have a mollic epipedon, which is definitive for the series.

Nodaway Series

The Nodaway series consists of moderately well drained, moderately permeable soils on bottom land. These soils formed in silty recent alluvium. The native vegetation was tall prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Nodaway silt loam, 0 to 2 percent slopes, in a pasture on a southeast-facing first bottom; 330 feet west and 1,780 feet south of the northeast corner of sec. 36, T. 69 N., R. 30 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam (27 percent clay and 14 percent sand), grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of dark grayish brown (10YR 4/2) underlying material; moderate medium and fine blocky structure parting to weak very fine subangular blocky; friable; neutral; clear smooth boundary.

C1—7 to 14 inches; stratified very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) silt loam (25 percent clay and 17 percent fine sand); few fine faint brown (10YR 4/3) mottles; appears massive, parting to weak thick platy fragments; friable; neutral; gradual smooth boundary.

C2—14 to 37 inches; stratified very dark gray (10YR 3/1), dark grayish brown (10YR 4/2), and grayish brown (10YR 5/2) silt loam (26 percent clay and 18 percent sand); few fine distinct strong brown (7.5YR 5/6) iron oxide stains; appears massive, parting to weak thick platy fragments; friable; neutral; gradual smooth boundary.

C3—37 to 60 inches; stratified very dark gray (10YR 3/1), dark grayish brown (10YR 4/2), and grayish brown (10YR 5/2) silt loam (25 percent clay and 15 percent sand); few fine distinct strong brown (7.5YR 5/6) iron oxide stains; appears massive, parting to weak thick platy fragments; friable; neutral.

The Ap horizon has chroma of 1 or 2. The matrix colors in the C horizon have value of 3 or 4 and chroma of 1 or 2. In some pedons strata have value of 4 or 5 and chroma of 2 to 4.

Olmitz Series

The Olmitz series consists of moderately well drained, moderately permeable soils on slightly concave foot slopes and alluvial fans. These soils formed in loamy local alluvium. The native vegetation was tall prairie grasses. Slope ranges from 2 to 9 percent.

Typical pedon of Olmitz loam, 5 to 9 percent slopes, in a cultivated field on a west-facing alluvial fan; 220 feet west and 130 feet north of the southeast corner of sec. 36, T. 70 N., R. 28 W.

Ap—0 to 7 inches; black (10YR 2/1) and very dark brown (10YR 2/2) loam (about 25 percent clay and 30 percent sand), dark grayish brown (10YR 4/2)

and very dark grayish brown (10YR 3/2) dry; moderate fine granular and moderate fine subangular blocky structure; friable; common fine roots; medium acid; clear smooth boundary.

A—7 to 25 inches; very dark grayish brown (10YR 3/2) loam (about 26 percent clay and 30 percent sand), dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) dry, very dark grayish brown (10YR 3/2) kneaded; weak medium and fine subangular blocky structure parting to moderate fine granular; friable; few fine roots; about 3 percent 1-millimeter pebbles; medium acid; gradual smooth boundary.

BA—25 to 30 inches; dark brown (10YR 3/3) clay loam (about 32 percent clay and 25 percent sand), dark brown (10YR 4/3) and dark grayish brown (10YR 4/2) dry, very dark grayish brown (10YR 3/2) kneaded; very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; few fine roots; about 4 percent 1-millimeter pebbles; medium acid; gradual smooth boundary.

Bw1—30 to 36 inches; dark brown (10YR 3/3) clay loam (about 34 percent clay), brown (10YR 5/3) dry, dark brown (10YR 4/3) kneaded; very dark grayish brown (10YR 3/2) coatings on faces of peds; few fine faint dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots; about 6 percent 1-millimeter pebbles; medium acid; gradual smooth boundary.

Bw2—36 to 43 inches; brown (10YR 4/3) clay loam (about 33 percent clay); dark grayish brown (10YR 4/2) coatings on faces of peds; common medium distinct dark yellowish brown (10YR 4/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; few fine roots; about 6 percent 1-millimeter pebbles; medium acid; gradual smooth boundary.

BC—43 to 60 inches; brown (10YR 4/3) clay loam (about 33 percent clay); dark grayish brown (10YR 4/2) coatings on faces of peds; common medium distinct dark yellowish brown (10YR 4/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; few fine roots; about 4 percent 1-millimeter pebbles; medium acid.

The solum ranges from 36 to more than 60 inches in thickness. It has no stones. Carbonates typically are leached to a depth of 6 or more feet. The thickness of the mollic epipedon ranges from 24 to 36 inches.

In some pedons the recent deposits are as much as 12 inches thick. They have value of 3 or 4. The Bw horizon is clay loam in which the content of clay ranges from 28 to 34 percent.

Pershing Series

The Pershing series consists of moderately well drained or somewhat poorly drained, slowly permeable soils on ridges and side slopes in the uplands and on loess-covered stream benches. These soils formed in loess. The native vegetation was mixed grasses and trees. Slope ranges from 2 to 14 percent.

Typical pedon of Pershing silt loam, 5 to 9 percent slopes, in a wooded area on a west-facing, convex ridge; 360 feet east and 2,220 feet north of the southwest corner of sec. 26, T. 68 N., R. 29 W.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam (26 percent clay), dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) dry; very dark gray (10YR 3/1) and black (10YR 2/1) coatings on faces of peds; moderate fine granular structure; friable; common medium and fine roots; slightly acid; clear smooth boundary.

E—6 to 10 inches; dark grayish brown (10YR 4/2) silt loam (26 percent clay), grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) dry; dark gray (10YR 4/1) coatings on faces of peds; weak thin platy and weak fine angular blocky structure; friable; light gray (10YR 7/1 dry) silt coatings on faces of peds; common medium and fine roots; strongly acid; clear smooth boundary.

Bt1—10 to 15 inches; brown (10YR 4/3) silty clay loam (36 percent clay), brown (10YR 5/3) dry; few fine faint yellowish brown (10YR 5/6) mottles; moderate fine angular blocky structure; friable; many distinct dark grayish brown (10YR 4/2) clay films and light gray (10YR 7/1 dry) silt coatings on faces of peds; common medium and fine roots; medium acid; clear smooth boundary.

Bt2—15 to 24 inches; dark grayish brown (10YR 4/3) silty clay (42 percent clay); common medium distinct strong brown (7.5YR 5/8) mottles; moderate fine and medium angular blocky structure; firm; many distinct dark grayish brown (10YR 4/2) clay films and light gray (10YR 7/1 dry) silt coatings on faces of peds; few fine roots; few fine dark concretions of manganese oxide; strongly acid; gradual smooth boundary.

Bt3—24 to 33 inches; grayish brown (10YR 5/2) silty clay (41 percent clay); common medium distinct strong brown (7.5YR 5/8) and few medium prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure parting to moderate fine angular blocky; firm; many distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few fine roots; few dark concretions

of manganese oxide; strongly acid; gradual smooth boundary.

Bt4—33 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam (38 percent clay); common medium distinct yellowish brown (10YR 5/6) and common medium prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure parting to weak fine angular blocky; firm; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few fine roots; few dark concretions of manganese oxide; strongly acid; gradual smooth boundary.

Bt5—43 to 51 inches; light brownish gray (2.5Y 6/2) silty clay loam (37 percent clay); common medium prominent yellowish brown (10YR 5/6) and few fine prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure; firm; common distinct grayish brown (10YR 5/2) clay films on faces of peds; few fine roots; few dark concretions of manganese oxide; strongly acid; gradual smooth boundary.

Bt6—51 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam (35 percent clay); common medium prominent strong brown (7.5YR 5/8) and few fine prominent yellowish red (5YR 5/8) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; few distinct grayish brown (10YR 5/2) clay films on faces of peds; few fine roots; few dark concretions of manganese oxide; strongly acid.

The thickness of the solum typically is 6 or more feet but ranges from 4 to 8 feet. Generally, the soils have no free carbonates within a depth of 10 feet.

The A or Ap horizon has chroma of 1 or 2. It is silt loam or silty clay loam. It is 6 to 9 inches thick. The E horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. It is 0 to 6 inches thick. The upper part of the Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 8. It is silty clay or silty clay loam. The lower part has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 to 6.

The moderately eroded Pershing soils in this county have a thinner dark surface layer than is definitive for the series.

Sharpsburg Series

The Sharpsburg series consists of moderately well drained, moderately slowly permeable soils on ridges and side slopes in the uplands and on benches. These soils formed in loess. The native vegetation was tall prairie grasses. Slope ranges from 2 to 14 percent.

Typical pedon of Sharpsburg silty clay loam, 2 to 5 percent slopes, in a cultivated field on a south-facing,

convex ridgetop; 180 feet east and 2,230 feet north of the southwest corner of sec. 6, T. 70 N., R. 31 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam (30 percent clay), dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry, very dark grayish brown (10YR 3/2) rubbed; weak fine granular and weak fine subangular blocky structure; friable; common fine roots; medium acid; abrupt smooth boundary.

A—8 to 17 inches; very dark grayish brown (10YR 3/2) silty clay loam (35 percent clay), dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) dry; black (10YR 2/1) organic coatings on faces of peds; weak fine and very fine subangular blocky structure parting to moderate fine granular; friable; few fine roots; medium acid; clear smooth boundary.

Bt1—17 to 25 inches; dark brown (10YR 4/3) silty clay loam (36 percent clay); very dark gray (10YR 3/1) and dark gray (10YR 4/1) organic coatings on faces of peds; moderate fine and very fine subangular blocky structure; friable; few fine roots; medium acid; clear smooth boundary.

Bt2—25 to 35 inches; brown (10YR 5/3) silty clay loam (36 percent clay); few fine distinct yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) mottles in the lower part; moderate fine subangular blocky structure; firm; many distinct dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) clay films on faces of peds; very few fine roots; few fine dark concretions of manganese oxide; medium acid; gradual smooth boundary.

Bt3—35 to 48 inches; grayish brown (2.5Y 5/2) silty clay loam (34 percent clay); common fine prominent strong brown (7.5YR 5/6) and common fine prominent yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; firm; thin discontinuous grayish brown (10YR 5/2) clay films on faces of peds; very few fine roots; few fine and medium dark concretions of manganese oxide; medium acid; gradual smooth boundary.

BC—48 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam (33 percent clay); common fine and medium prominent strong brown (7.5YR 5/8) mottles; weak medium and fine prismatic structure; friable; few distinct grayish brown (10YR 5/2) clay films on faces of peds; few fine dark concretions of manganese oxide; medium acid.

The solum typically is 4 to more than 6 feet thick on the more stable divides and is as thin as 3 feet on the steeper slopes. The soils have no free carbonates within a depth of 10 feet.

The A horizon typically is 10 to 24 inches thick but is

thinner in eroded areas. The upper part of the Bt horizon has value of 4 or 5 and chroma of 3 or 4. The lower part has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 or 3. The Bt horizon typically is silty clay loam in which the content of clay ranges from 35 to 40 percent. Some pedons have BC and C horizons. These horizons have hue of 10YR to 5Y, value of 5 or 6, and chroma of 2 to 4. The BC horizon and the upper part of the C horizon typically are silty clay loam in which the content of clay ranges from 30 to 38 percent.

The moderately eroded Sharpsburg soils in the county do not have a mollic epipedon, which is definitive for the series.

Shelby Series

The Shelby series consists of well drained, moderately slowly permeable soils on narrow, convex ridges and side slopes in the uplands. These soils formed in glacial till (fig. 14). The native vegetation was tall prairie grasses. Slope ranges from 9 to 18 percent.

Typical pedon of Shelby clay loam, 9 to 14 percent slopes, in a cultivated field on an east-facing, convex side slope; 287 feet east and 575 feet north of the southwest corner of sec. 36, T. 70 N., R. 31 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) clay loam (about 28 percent clay), dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; many fine roots; about 1 percent 5-millimeter pebbles; slightly acid; clear smooth boundary.

AB—8 to 12 inches; dark brown (10YR 3/3) and dark yellowish brown (10YR 4/4) clay loam (about 29 percent clay); very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium and fine subangular blocky structure; friable; few fine roots; about 2 percent 5-millimeter pebbles; slightly acid; clear smooth boundary.

Bt1—12 to 17 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) clay loam (about 32 percent clay); common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; few fine roots; about 3 percent 5-millimeter pebbles; neutral; clear smooth boundary.

Bt2—17 to 27 inches; yellowish brown (10YR 5/6) clay loam (about 35 percent clay); weak medium subangular blocky structure parting to moderate fine subangular blocky; firm; few distinct brown (10YR 5/3) clay films on faces of peds; few fine roots; few fine dark concretions of manganese oxide; about 3



Figure 14.—Profile of Shelby clay loam. Shelby soils formed in glacial till.

percent 5-millimeter pebbles; neutral; gradual smooth boundary.

Bt3—27 to 38 inches; yellowish brown (10YR 5/6) clay loam (about 34 percent clay); few fine distinct pale brown (10YR 6/3) mottles; weak medium prismatic

structure parting to weak medium subangular blocky; firm; few distinct yellowish brown (10YR 5/4) clay films on faces of peds; few fine roots; few fine dark concretions of manganese oxide; about 3 percent 5-millimeter pebbles; neutral; clear smooth boundary.

C—38 to 60 inches; yellowish brown (10YR 5/6) clay loam (about 32 percent clay); few fine distinct pale brown (10YR 6/3) mottles; massive; firm; few fine roots; few dark concretions of manganese oxide; common medium and fine accumulations of calcium carbonate; about 3 percent 5-millimeter pebbles; slightly effervescent; mildly alkaline.

The solum ranges from 30 to 60 inches in thickness. Free carbonates generally are at a depth of 30 to 60 inches but are closer to the surface in eroded areas. A few stones and pebbles are throughout the profile.

The A or Ap horizon has value of 2 or 3 and chroma of 1 or 2. The A and AB horizons generally are 10 to 14 inches thick but are thinner in eroded areas. They are dominantly clay loam but in some pedons are loam. The Bt horizon has value of 3 to 5. It typically is clay loam in which the content of clay ranges from 32 to 35 percent.

The moderately eroded Shelby soils in this county do not have a mollic epipedon, which is definitive for the series.

Wabash Series

The Wabash series consists of very poorly drained, very slowly permeable soils on bottom land. These soils formed in clayey alluvium. The native vegetation was tall prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Wabash silty clay, 0 to 2 percent slopes, in a cultivated field on a first bottom; 760 feet west and 2,400 feet south of the northeast corner of sec. 22, T. 69 N., R. 31 W.

Ap—0 to 8 inches; black (N 2/0) silty clay (52 percent clay), very dark gray (N 3/0) dry; moderate fine subangular blocky structure; firm; few medium roots; neutral; clear smooth boundary.

A—8 to 13 inches; black (10YR 2/1) and (N 2/0) silty clay (59 percent clay), very dark gray (10YR 3/1) and black (N 2/0) dry; weak and moderate fine subangular blocky structure; firm; few medium roots; slightly acid; gradual smooth boundary.

AB—13 to 20 inches; black (N 2/0) silty clay (58 percent clay), very dark gray (10YR 3/1) dry; weak medium and fine subangular blocky structure; firm; few very fine roots; slightly acid; gradual smooth boundary.

Bg1—20 to 38 inches; black (N 2/0) and about 30 percent very dark gray (10YR 3/1) silty clay (59

percent clay); few fine faint dark grayish brown (2.5Y 4/2) mottles; moderate medium and fine subangular blocky structure; very firm; few pressure faces on peds; neutral; gradual smooth boundary.

Bg2—38 to 60 inches; black (N 2/0) and about 40 percent very dark gray (10YR 3/1) silty clay (58 percent clay); common medium faint olive brown (2.5Y 4/4) mottles; moderate medium subangular blocky structure; very firm; few pressure faces on peds; neutral.

The thickness of the solum ranges from 40 to more than 60 inches. The depth to free carbonates is more than 40 inches. The mollic epipedon is 18 to 28 inches thick.

The A and Ap horizons have hue of 10YR to 5Y, value of 2 or 3, and chroma of 2 or less. They are dominantly silty clay but in some pedons are silty clay loam. The part of the Bg horizon within a depth of 36 inches has matrix colors similar to those of the A horizon. The part below a depth of 36 inches has value of 4 or 5 in some pedons. The Bg horizon has mottles that have hue of 10YR to 2.5Y, value of 4 or 5, and chroma of 2 to 8. It commonly is silty clay or clay. The content of clay in this horizon ranges from 46 to 60 percent.

Weller Series

The Weller series consists of moderately well drained, slowly permeable soils on narrow ridges and short, convex side slopes in the uplands. These soils formed in loess. The native vegetation was deciduous trees. Slope ranges from 5 to 9 percent.

Typical pedon of Weller silt loam, 5 to 9 percent slopes, in a pasture on a north-facing, convex ridgetop; 730 feet east and 1,780 feet north of the southwest corner of sec. 21, T. 67 N., R. 29 W.

A—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam (21 percent clay), light brownish gray (10YR 6/2) dry; very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate thin platy structure parting to moderate fine granular; friable; few very fine roots; slightly acid; clear smooth boundary.

E—5 to 9 inches; brown (10YR 5/3) and pale brown (10YR 6/3) silt loam (22 percent clay), very pale brown (10YR 7/3) dry; moderate thin platy structure; friable; light gray (10YR 7/2 dry) few very fine roots; slightly acid; clear smooth boundary.

BE—9 to 15 inches; yellowish brown (10YR 5/4) silty clay loam (33 percent clay), very pale brown (10YR 7/4) dry; brown (10YR 5/3) coatings on faces of

pedes; moderate fine angular and subangular blocky structure; friable; light gray (10YR 7/2 dry) silt coatings on faces of pedes; few fine roots; strongly acid; gradual smooth boundary.

Bt1—15 to 22 inches; yellowish brown (10YR 5/4) silty clay (41 percent clay); dark grayish brown (10YR 4/2) coatings on faces of pedes; few fine faint grayish brown (10YR 5/2) mottles; moderate fine and medium angular blocky structure; firm; few faint brown (10YR 5/3) clay films on faces of pedes; few very fine roots; few dark concretions of manganese oxide; very strongly acid; gradual smooth boundary.

Bt2—22 to 32 inches; yellowish brown (10YR 5/4) silty clay (42 percent clay); common fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure parting to moderate very fine angular blocky; firm; many distinct grayish brown (10YR 5/2) clay films on faces of pedes; few very fine roots; few dark brown (7.5YR 4/4) concretions of iron oxide; very strongly acid; gradual smooth boundary.

Bt3—32 to 41 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) silty clay loam (38 percent clay); weak medium subangular blocky structure parting to moderate very fine angular blocky; firm; many distinct light brownish gray (10YR 5/2) clay films on faces of pedes; few fine roots; many dark concretions of manganese oxide; very strongly acid; gradual smooth boundary.

Bt4—41 to 51 inches; light brownish gray (2.5Y 6/2) silty clay loam (37 percent clay); few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to weak very fine angular blocky; firm; many distinct grayish brown (10YR 5/2) clay films on faces of pedes; common dark concretions of manganese oxide; common strong brown (7.5YR 4/6) concretions of iron oxide; strongly acid; gradual smooth boundary.

Bt5—51 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam (35 percent clay); few fine distinct yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; thin discontinuous grayish brown (10YR 5/2) clay films on faces of pedes; common dark concretions of manganese oxide; common strong brown (7.5YR 5/8) concretions of iron oxide; medium acid.

The thickness of the solum typically ranges from 48 to more than 60 inches. The soils have no free carbonates within a depth of 6 feet.

The A or Ap horizon has value of 4 or 5 and chroma of 1 to 3. It is 3 to 6 inches thick. In eroded areas the

Ap horizon typically is silty clay loam, but the range includes silt loam. The E horizon has value of 4 or 5 and chroma of 2 or 3. It is less than 6 inches thick. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. The mottles in this horizon have hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 2 to 6. The maximum content of clay in the Bt horizon ranges from 42 to 48 percent.

Winterset Series

The Winterset series consists of poorly drained, moderately slowly permeable soils on broad upland flats. These soils formed in loess. The native vegetation was tall prairie grasses. Slope ranges from 0 to 2 percent.

Typical pedon of Winterset silty clay loam, 0 to 2 percent slopes, in a cultivated field on a broad, upland flat; 248 feet west and 1,690 feet south of the northeast corner of sec. 6, T. 68 N., R. 31 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam (29 percent clay), dark gray (10YR 4/1) dry, very dark gray (10YR 3/1) rubbed; moderate very fine subangular blocky structure; friable; few fine roots; medium acid; abrupt smooth boundary.

A—7 to 12 inches; black (10YR 2/1) silty clay loam (37 percent clay), dark gray (10YR 4/1) and gray (10YR 5/1) dry, very dark gray (10YR 3/1) rubbed; few fine faint very dark brown (10YR 2/2) mottles; weak fine subangular blocky structure parting to weak fine granular; friable; few fine roots; medium acid; clear smooth boundary.

AB—12 to 17 inches; very dark gray (10YR 3/1) silty clay loam (37 percent clay), dark gray (10YR 4/1) and gray (10YR 5/1) dry; very dark gray (10YR 3/1) coatings on faces of pedes; common medium distinct dark grayish brown (10YR 4/2) and brown (10YR 4/3) mottles; weak medium subangular blocky structure parting to moderate fine granular; friable; few fine roots; medium acid; clear smooth boundary.

Btg1—17 to 25 inches; dark gray (10YR 4/1) silty clay (41 percent clay); common medium faint dark grayish brown (10YR 4/2) and common fine distinct yellowish brown (10YR 5/8) mottles; moderate fine subangular blocky structure; firm; few distinct very dark gray (10YR 3/1) clay films on faces of pedes; few fine roots; few dark concretions of manganese oxide; medium acid; clear smooth boundary.

Btg2—25 to 38 inches; grayish brown (2.5Y 5/2) silty clay (40 percent clay); common fine distinct strong brown (7.5YR 5/8) mottles; moderate medium

subangular blocky structure parting to moderate fine subangular blocky; firm; few distinct gray (10YR 5/1) and dark gray (10YR 4/1) clay films on faces of peds; few fine roots; few dark concretions of manganese oxide; medium acid; gradual smooth boundary.

BCg—38 to 50 inches; grayish brown (2.5Y 5/2) silty clay loam (37 percent clay); many medium distinct yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; many distinct grayish brown (2.5Y 5/2) and gray (10YR 5/1) clay films on faces of peds; few fine roots; common fine dark concretions of manganese oxide; slightly acid; gradual smooth boundary.

Cg—50 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam (34 percent clay); many moderate distinct strong brown (7.5YR 5/8) and few fine prominent strong brown (7.5YR 4/6) mottles; massive; friable; common fine dark concretions of manganese oxide; slightly acid.

The thickness of the solum ranges from 48 to 72 inches. The soils have no free carbonates in the solum or in the upper part of the C horizon.

The A horizon has hue of 10YR or 2.5Y or is neutral in hue. It has chroma of 0 or 1. The thickness of the A horizon combined with that of the AB horizon is 16 to 22 inches. These horizons typically are silty clay loam but in some pedons are silt loam. The Btg horizon has hue of 10YR to 5Y and value of 3 to 5. In some pedons it has common or many mottles with hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. By weighted average, the content of clay in the upper 20 inches of the argillic horizon ranges from 38 to 42 percent. The BCg and Cg horizons have hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2.

Zook Series

The Zook series consists of poorly drained, slowly permeable soils on bottom land, foot slopes, and alluvial fans. These soils formed in alluvium. The native vegetation was tall prairie grasses. Slope ranges from 0 to 5 percent.

Typical pedon of Zook silty clay loam, 0 to 2 percent slopes, in a cultivated field on a flood plain; 2,430 feet

west and 630 feet south of the northeast corner of sec. 21, T. 70 N., R. 31 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam (35 percent clay), very dark gray (10YR 3/1) and gray (10YR 6/1) dry, black (N 2/0) crushed; weak fine subangular and weak fine granular structure; friable; few fine roots; slightly acid; abrupt smooth boundary.

A1—9 to 16 inches; black (N 2/0) silty clay loam (38 percent clay), very dark gray (10YR 3/1) and black (10YR 2/1) dry, black (10YR 2/1) rubbed; moderate fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

A2—16 to 27 inches; black (N 2/0) silty clay (46 percent clay), black (N 2/0) dry, black (10YR 2/1) rubbed; weak medium and fine subangular blocky structure; firm; few fine roots; neutral; clear smooth boundary.

A3—27 to 36 inches; very dark gray (N 3/0) silty clay (43 percent clay), very dark gray (N 3/0) and black (N 2/0) dry; black (N 2/0) coatings on faces of peds; weak fine and medium prismatic structure parting to moderate fine subangular blocky; firm; few fine roots; neutral; gradual smooth boundary.

Bg—36 to 50 inches; black (10YR 2/1) silty clay (42 percent clay); very dark gray (N 3/0) coatings on faces of peds; moderate medium prismatic structure parting to moderate and fine subangular blocky; firm; neutral; gradual smooth boundary.

Cg—50 to 60 inches; gray (5Y 5/1) silty clay (42 percent clay); dark gray (N 4/0) coatings on faces of peds; common medium prominent olive yellow (2.5Y 6/6) mottles; appears massive but has some vertical cleavage planes; firm; neutral.

The solum ranges from about 36 to 60 inches in thickness. It typically is silty clay loam or silty clay. It contains about 32 to 44 percent clay to a depth of 16 inches and about 36 to 50 percent clay below that depth. The C horizon also contains about 36 to 50 percent clay to a depth of 48 inches or more. The mollic epipedon is 36 to 50 inches thick. The soils have value of 3 or less to a depth of more than 36 inches.

The A horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. The Bg horizon has hue of 10YR or 2.5Y and value of 2 to 4. The Cg horizon has hue of 2.5Y or 5Y and value of 4 or 5.

Formation of the Soils

In this section, the factors of soil formation are related to the soils in Ringgold County and the processes that result in the formation of soil horizons are described.

Factors of Soil Formation

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material (9). Human activities also affect soil formation.

Climate and plant and animal life, chiefly plants, are the active factors in the formation of soil. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the transformation of parent material into a soil. Some time is always required for horizon differentiation. A long period generally is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the others.

Parent Material

The accumulation of parent material is the first step in the formation of a soil. Most of the soils formed in material that was transported from the site of the parent rock and redeposited at a new location through the action of glacial ice, water, wind, and gravity. The principal kinds of parent material in Ringgold County

are loess, glacial till, sandy eolian material, alluvium, and colluvium (fig. 15).

Loess, or silty material deposited by the wind, covers about 24 percent of Ringgold County. It is about 8 to 12 feet thick on the more stable ridges and less than 4 feet to 8 feet thick on the side slopes. It overlies a paleosol weathered from glacial till and in some areas overlies both glacial till and valley fill. The base of the Wisconsin loess in Iowa is 14,000 to 29,000 years old (14, 16).

Loess consists mostly of silt and some clay. It does not contain coarse sand or gravel, which are too large to be moved by the wind, but it does contain small amounts of fine and very fine sand, generally less than 5 percent. The major source of loess in Ringgold County was probably the flood plains along the Missouri River and its tributaries in western Iowa. The thickness of the loess and the content of clay in the loess are related to the distance from the source.

Glacial till is an unsorted, unstratified, heterogeneous mixture of clay, sand, gravel, and boulders. It is the second most extensive parent material in Ringgold County. The first of the glacial advances over Ringgold County was the Nebraskan Glaciation, which occurred about 750,000 years ago (10, 17). It was followed by the Kansan Glaciation, which began about 500,000 years ago. As they retreated, the glaciers left behind a vast deposit of glacial till. Nebraskan till can be identified only in a few areas in the county. Kansan till is exposed on the steeper slopes in all parts of the county and forms an extensive part of the landscape.

Soils formed on the Nebraskan till plain during the Aftonian interglacial period before the Kansan Glaciation. These soils are called the Aftonian paleosol, which is strongly weathered, very slowly permeable, gray clay a few feet to several feet thick. The Aftonian paleosol is exposed in small areas in the southern third of the county. Only a few areas are large enough to be delineated separately. Most are identified on the soil maps by a gray clay spot symbol.

Soils formed on the Kansan till plain during the Yarmouth and Sangamon interglacial periods before the loess was deposited. In nearly level areas the soils

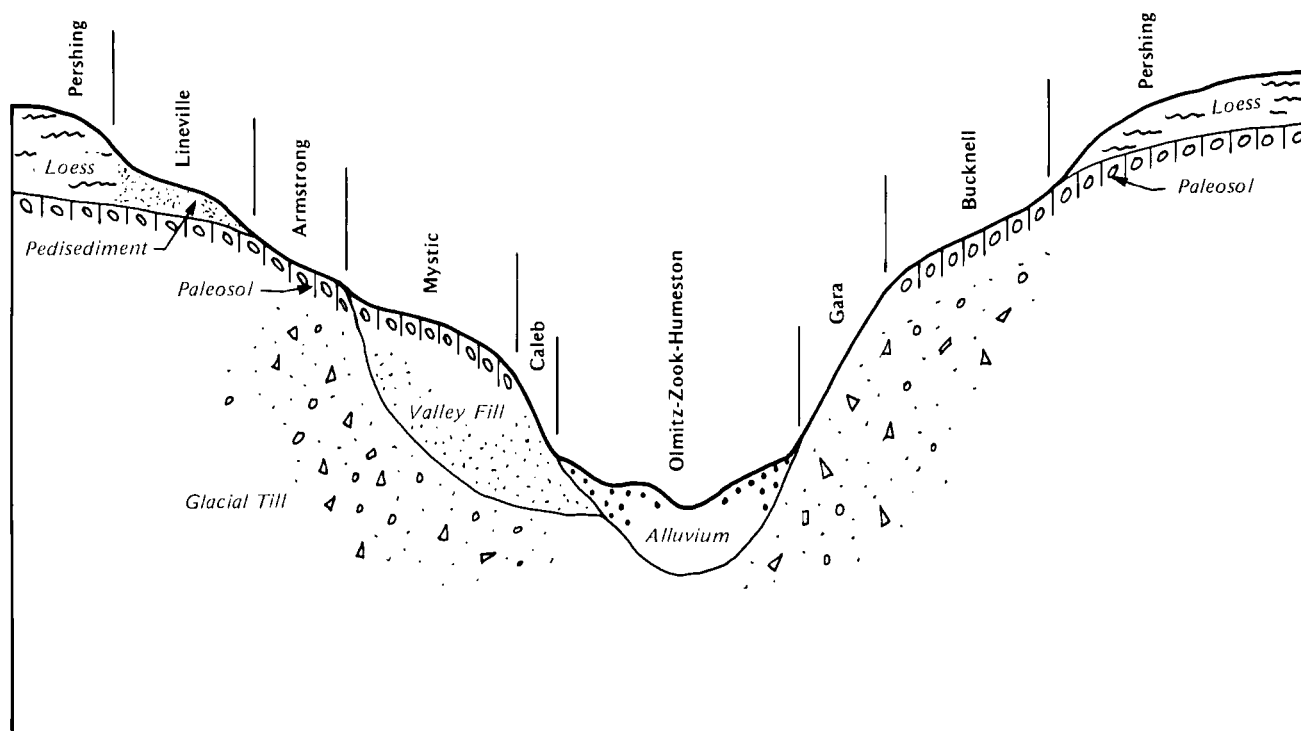


Figure 15.—Relationship of the major soils in Ringgold County to parent material and to position on the landscape.

were strongly weathered and have a thick gray, plastic, clayey subsoil called "gumbotil." These soils also are called paleosols, or "ancient soils" (12, 15). These paleosols are several feet thick and are very slowly permeable. Clarinda soils formed in these paleosols. They are extensive throughout Ringgold County. Bucknell and Lamoni soils formed in the truncated Yarmouth-Sangamon paleosol. They have a layer of clay that is not so thick as that of the Clarinda soils. Lamoni soils are extensive throughout Ringgold County.

Late in the Sangamon period, geologic erosion cut through the Yarmouth-Sangamon paleosol and into the Kansan till. At the depth to which this erosion has cut, a stone line or subjacent till generally is overlain by pedisements (11, 13). A paleosol formed in this material. Geologic erosion removed the loess from many slopes and exposed the paleosol. The Late Sangamon paleosol generally is reddish and is thinner than the Yarmouth-Sangamon paleosol. Adair, Armstrong, and Keswick soils formed in the Late Sangamon paleosol.

Caleb and Mystic soils formed in pre-Sangamon valley fill sediments. This material is sometimes called "ancient alluvium." It is of glacial origin and varies in texture (12). This material appears to have been angularly truncated in many places. It commonly occurs

as an irregular mixture of material of contrasting textures. These sediments are on low, stepped interfluvies and on escarpments on high stream benches above the present valley floor. They owe their landscape configuration partly to valley fill, but their surface merges with the present erosional uplands. Caleb and Mystic soils are above the flood plains, but they are lower on the landscape than Gara, Lindley, and Shelby soils, which formed in Kansan till on dissected slopes of Late Wisconsin age. Gara, Lindley, and Shelby soils are extensive throughout Ringgold County.

Sandy eolian material is not extensive in Ringgold County. It is deposited along the valley of the Platte River. It is much higher in content of sand than the deposits of loess. It consists largely of fine and very fine quartz that is highly resistant to weathering. It has not been altered appreciably since it was deposited. It is underlain by till at various depths. Dickinson soils formed mainly in sandy eolian material.

Alluvium is material deposited by water. Alluvial deposits of Late Wisconsin age are on flood plains and low stream terraces along the major and minor streams. They also are in drainageways on uplands. About 21 percent of the soils in the county formed in alluvial material.

The texture of the alluvium varies widely because the source of material and the manner in which it was deposited vary. Loess and glacial till are the main sources of alluvium in Ringgold County. As the streams overflow their channels, alluvium is deposited. The coarser or larger particles are deposited closer to the stream channel or in and along the main path of the floodwater. The finer particles are deposited in the areas farther away from the stream channel, where the floodwater moves slowly or is still. Ackmore, Kennebec, Nodaway, and Zook soils formed in silty alluvium, and Carlow and Wabash soils formed in clayey alluvium. The major areas of these soils are on the bottom land along the Grand and Platte Rivers and along Lotts, Squaw, and Wolf Creeks. Humeston soils are on low stream terraces and are flooded less frequently than the soils on flood plains. Also, they are characterized by more profile development.

Colluvium was deposited on or at the base of steep slopes by mass wasting and local unconcentrated runoff. It retains many of the characteristics of the soils on the slopes from which it was eroded. Olmitz soils formed in colluvium on the foot slopes below areas of soils that formed in till.

Climate

The soils in Ringgold County have been forming under the influence of a midcontinental, subhumid climate for at least 5,000 years. From 5,000 to 16,000 years ago, the climate favored the growth of forest vegetation (12). The influence of the general climate of the region is modified by local conditions. For example, soils on the south-facing slopes formed under a microclimate that is warmer and drier than the average climate in nearby areas. The climate under which poorly drained soils on bottom land have been forming is wetter and colder than that in most of the surrounding areas. These local conditions account for some of the differences among soils in the same climatic region.

Plant and Animal Life

Plant and animal life are important factors of soil formation. Plants are especially significant. Soil formation really begins with the growth of vegetation. As plants grow and die, they add organic material to the upper layers of the soil material.

The soils of Ringgold County appear to have been influenced in recent times by two main kinds of plants—prairie grasses and deciduous trees. The main prairie grasses were big bluestem, little bluestem, and switchgrass. The trees were mainly oak, hickory, locust, elm, maple, and other deciduous trees. The native grasses have myriads of fibrous roots that penetrate the

soil to a depth of 10 to 20 inches and add large amounts of organic material to the surface layer. Trees commonly feed on plant nutrients deep in the subsoil. Consequently, they add little organic matter to the surface layer other than that added by fallen leaves and dead trees. Much of the organic matter from dead trees remains on the surface.

Grundy, Haig, and Shelby are typical examples of soils that formed under prairie vegetation. Wabash and Zook are typical examples of soils that formed under prairie grasses and water-tolerant plants. Keswick, Lindley, and Weller are typical examples of soils that formed under trees. Armstrong, Gara, and Pershing soils have properties intermediate between those of soils that formed entirely under prairie vegetation and those of soils that formed entirely under forest vegetation. Soils that formed under trees have a dark surface layer that generally is less than 5 inches thick. They have a lighter colored E horizon directly below the surface layer. In contrast, soils that formed under prairie vegetation contain a large amount of organic matter derived from roots and have a thick, dark surface layer.

Grundy, Pershing, and Weller soils are members of the biosequence, or a group of soils that formed in the same kind of parent material and in a similar environment but that supported different kinds of native vegetation. Variations in the native vegetation caused the main morphological differences among the soils in this group.

The activities of burrowing animals and insects have some effect on soil formation. They loosen and aerate the upper few feet of the soils.

Relief

Relief can cause important differences among soils. Indirectly, it influences soil formation through its effect on drainage. The soils in Ringgold County range from nearly level to very steep. Many nearly level soils are frequently flooded and have a seasonal high water table. Water soaks into the nearly level soils that are not flooded. Much of the rainfall runs off the surface of the more sloping soils and less of it penetrates the surface.

Haig and Winterset soils formed under the influence of a seasonal high water table and have a dominantly olive gray subsoil. Soils that formed in areas where the water table was below the subsoil have a yellowish brown subsoil. Examples are Gara, Ladoga, Sharpsburg, and Shelby soils. Grundy, Macksburg, Nevin, Pershing, and other soils that formed in areas where natural drainage was intermediate have a grayish brown, mottled subsoil. Of the soils that formed under prairie vegetation, those that have a higher water table

generally have more organic matter in the surface layer than do those that are characterized by good natural drainage.

Gara, Lindley, and Shelby soils have a wide range of slopes. They have some properties that change as slope increases. Carbonates are closer to the surface where slopes are steepest. The surface layer is thinner in the steeper areas. The maximum content of clay in the B horizon and depth to the zone of maximum clay content decrease with increasing slope (4, 11).

Aspect and position on the landscape significantly affect soil formation. South-facing slopes generally are warmer and drier than north-facing slopes and consequently support different kinds and amounts of vegetation. Ely soils are on foot slopes and in some upland drainageways. They have properties similar to the higher lying soils from which they receive sediments.

Time

Time is necessary for the various processes of soil formation. The amount of time necessary ranges from a few days for the deposition of fresh alluvial material in areas of Nodaway silt loam, channeled, 0 to 2 percent slopes, to a thousand years or more for the formation of a subsoil in many of the older soils on uplands. The age of the parent material does not necessarily reflect the true age of a soil that formed in the material. The age of the soil is reflected by the degree of profile development.

Older or more strongly developed soils have well defined genetic horizons and have a higher content of clay in the subsoil than younger soils that formed in a similar kind of parent material. As a soil forms, clay is moved from the surface layer to the subsoil. This transfer is more evident in a nearly level soil than in a more sloping soil. The younger soils have weakly developed horizons. Some of the soils that formed in alluvium show little or no evidence of profile development because they periodically receive fresh material when they are flooded. The soil material has not been in place long enough for the formation of well defined genetic horizons.

If other factors are favorable, the texture of the subsoil generally becomes finer and a greater amount of soluble material is leached out as the soils continue to weather. Exceptions are Dickinson and other soils that formed in quartz sand or in other material that is resistant to weathering. These soils do not change much over a long period. On the steeper soils material is generally removed before enough time has elapsed for the development of strongly expressed horizons. Even though the material has been in place a long time,

the soils still exhibit little evidence of profile development because much of the water runs off the surface rather than through the profile.

Where organic material has been buried by later deposition through the action of ice, water, or wind, the age of a landscape can be determined by a process known as radiocarbon dating. The loess in which Grundy, Pershing, and Weller soils formed is probably about 14,000 to 20,000 years old.

Human Activities

Important changes took place when Ringgold County was settled. Some had little effect on soil productivity; others had drastic effects. The most apparent effects are those caused by water erosion. Breaking the prairie sod and clearing the timber removed and changed the protective plant cover.

Cultivation increases the susceptibility of the more sloping soils to erosion, which removes topsoil, organic matter, and plant nutrients. Sheet erosion, which is the most prevalent kind of erosion in this county, removes a few inches of topsoil at a time, but cultivation generally destroys all evidence of this loss. In some areas, shallow and deep gullies have formed and the material removed through erosion has been deposited on the lower slopes.

As the land was brought under cultivation, the runoff rate increased and the rate at which water moved into the soil decreased. As a result, accelerated erosion has removed part or all of the original surface layer from many of the more sloping soils. Erosion has changed not only the thickness of the surface layer but also its structure and consistence. In severely eroded areas the plow layer commonly includes the upper part of the subsoil, which is less friable and finer textured than the surface layer.

Erosion and cultivation also affect the soil by reducing the organic matter content and the level of fertility. Even in areas that are not subject to erosion, compaction caused by heavy machinery reduces the thickness of the surface layer and changes the soil structure. The granular structure so apparent on natural grassland breaks down under intensive cropping.

The surface soil tends to bake and become hard when dry. Fine textured soils that have been plowed year after year during wet periods tend to puddle and are less permeable than similar soils in undisturbed areas.

Ackmore and Nodaway soils, which formed in recent alluvium, show the influence of human activities. They have strata of light and dark material washed from the hillsides and deposited by floods. This erosion began when the hillsides were first cultivated.

Some human activities have increased the productivity of the soils, decreased soil loss, and reclaimed areas that are not suitable for crops or pasture. For example, terraces and other measures have helped to control runoff and erosion. Diversions at the base of slopes and of drainage ditches have helped to prevent flooding and deposition and thus have made large areas of bottom land suitable for cultivation. Applications of commercial fertilizer and lime have corrected deficiencies in plant nutrients, so that many soils are more productive now than they were in their natural state.

Water erosion is responsible for most of the loss of organic matter in soils. As much as a third of the organic matter, however, can be lost through other means (19). Maintaining as high a reserve of organic matter as was originally present under native grasses is not economically feasible. Measures that maintain a level that is adequate for crops, however, are needed.

Processes of Horizon Differentiation

Horizon differentiation is caused by four basic kinds of change. These are additions, removals, transfers, and transformations (17). Each of these kinds of change affects many substances that make up soils, such as organic matter, soluble salts, carbonates, sesquioxides, and silicate clay minerals.

In general, these processes tend to promote horizon differentiation, but some tend to offset or retard it. These processes and the resulting changes proceed simultaneously in soils, and the ultimate nature of the profile is governed by the balance of these changes within the profile.

An accumulation of organic matter is an early step in the process of horizon differentiation in most soils. The surface layer of the soils in Ringgold County ranges from very high to very low in the content of organic matter. Weller and other soils have a thin surface layer that is low in organic matter content. Wabash and Zook are examples of soils that have a thick surface layer in which the content of organic matter is high. In some soils the content formerly was quite high but is now low because of erosion.

The removal of substances from parts of the soil profile is important in the differentiation of soil horizons

in Ringgold County. The downward movement of calcium carbonates and bases is an example. The upper part of all the soils in the county has been leached of calcium carbonates.

The transfer of substances from one horizon to another is evident in the soils of this county. Phosphorus is removed from the subsoil by plant roots and transferred to parts of the plant growing above the ground. It is then added to the surface layer in the plant residue. This process affects the forms and the distribution of phosphorus in the profile.

The translocation of silicate clay minerals is an important process of horizon differentiation. The clay minerals are carried downward in suspension in percolating water from the A horizon. They accumulate in the B horizon in pores and root channels and as clay films on faces of peds. This process has influenced many of the soils in Ringgold County. In other soils, the content of clay in the A horizon is not markedly different from that in the B horizon and other evidence of clay movement is minimal.

Another kind of transfer that occurs to some extent in very clayey soils is that brought about by shrinking and swelling. Cracks form as the soils shrink and swell. As a result, some material from the surface layer is transferred to the lower parts of the profile. Carlow and Wabash are examples of soils with potential for this kind of physical transfer.

Transformations are physical or chemical. The weathering of soil particles to smaller sizes is an example of a physical transformation. Gleying, or the reduction of iron, is an example of a chemical transformation. This process occurs when poorly drained soils, such as Zook soils, are saturated for long periods. These soils have enough organic matter for biological activity to take place during the periods of saturation. Gleying is evidenced by the presence of ferrous iron and gray colors.

Another kind of transformation is the weathering of primary apatite minerals in the parent material to secondary phosphorus compounds. At a pH near 7, the primary mineral apatite is weathered to secondary phosphorus compounds. Thus, soils that have a pH of near 7, such as Zook soils, have more available phosphorus than soils that have a pH of more than 7, such as a calcareous soil.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon.

Commonly, such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvial fan. A fan-shaped deposit of sand, gravel, and fine textured material deposited by a stream where its gradient lessens abruptly.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Benches (geologic). High, old terraces (old alluvial plains) that are now a part of the erosion surface of the valley. In Iowa the benches are of pre-Wisconsin age and are covered with loess. In Ringgold County these areas are 5 to 15 feet above the modern flood plains and geologic terraces.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing

crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops

unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drainageway. Long, narrow, concave areas of alluvial soils on uplands where water concentrates and is transported to larger creeks and streams.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of the more gently sloping land surfaces and produced by erosion.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not

prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Interfluv. The area between rivers; especially the relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nose slope. The landform that is below the end of an interfluvium at the end of a drainage area of any size.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Paleosol. An old, weathered soil that formed during an interglacial period in the geologic past. It was buried by other geologic material and commonly reexposed on the modern surface by later geologic erosion.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. Water-sorted erosional sediment that covers a paleosol.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Puddled soil. A soil that is dense and massive because it has been compacted when wet. Commonly, a clayey soil that has been tilled when wet.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Second bottom. An area on flood plains that is slightly higher than a first bottom and is near stream channels and lower than geologic terraces or foot slopes in the uplands.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder slope. A short, convex part of a hillside directly below a ridgetop.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Side slope. The landform that slopes away from and runs parallel to interfluves.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $\text{Ca}^{++} + \text{Mg}^{++}$. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tile drainage. A system in which plastic, concrete, or ceramic pipe is installed at suitable depths and intervals in the soil to remove and transport excess water to outlets.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Upland divide. Broad, nearly level and level areas in the uplands.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION
(Recorded in the period 1951-84 at Mount Ayr, Iowa)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
	° F	° F	° F	° F	° F	Units	In	In	In		In
January-----	30.2	11.1	20.7	58	-19	0	0.85	0.24	1.36	2	4.9
February-----	37.4	17.2	27.3	63	-15	10	.95	.31	1.46	3	4.7
March-----	47.1	26.3	36.7	78	-3	29	2.26	.86	3.42	4	4.3
April-----	62.6	39.4	51.0	86	18	124	3.28	1.93	4.47	6	.7
May-----	72.7	50.5	61.6	88	30	367	4.11	2.43	5.61	7	.0
June-----	81.3	60.2	70.8	96	43	624	4.59	2.53	6.40	7	.0
July-----	86.0	64.2	75.1	98	49	778	4.01	1.68	5.98	6	.0
August-----	84.3	62.0	73.2	97	47	719	4.33	2.12	6.25	6	.0
September----	76.7	53.3	65.0	93	32	450	3.84	1.54	5.77	6	.0
October-----	66.5	42.5	54.5	87	20	191	2.88	.84	4.53	5	.2
November-----	50.2	29.7	40.0	73	4	12	2.06	.56	3.25	3	1.1
December-----	36.8	18.6	27.7	64	-9	0	1.20	.47	1.80	3	4.1
Yearly:											
Average----	61.0	39.6	50.3	---	---	---	---	---	---	---	---
Extreme----	---	---	---	101	-20	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,304	34.36	27.47	40.12	58	20.0

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL
(Recorded in the period 1951-84 at Mount Ayr, Iowa)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 20	Apr. 27	May 11
2 years in 10 later than--	Apr. 16	Apr. 23	May 6
5 years in 10 later than--	Apr. 6	Apr. 14	Apr. 26
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 14	Oct. 4	Sept. 24
2 years in 10 earlier than--	Oct. 19	Oct. 10	Sept. 30
5 years in 10 earlier than--	Oct. 30	Oct. 21	Oct. 10

TABLE 3.--GROWING SEASON
(Recorded in the period 1951-84 at Mount Ayr, Iowa)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	187	167	144
8 years in 10	193	174	152
5 years in 10	206	189	167
2 years in 10	218	204	182
1 year in 10	225	211	189

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
13B	Olmitz-Zook-Humeston complex, 0 to 5 percent slopes-----	28,415	8.0
23C	Arispe silty clay loam, 5 to 9 percent slopes-----	16,135	4.6
23C2	Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded-----	10,800	3.1
24D	Shelby clay loam, 9 to 14 percent slopes-----	2,485	0.7
24D2	Shelby clay loam, 9 to 14 percent slopes, moderately eroded-----	14,875	4.2
24E	Shelby clay loam, 14 to 18 percent slopes-----	1,385	0.4
24E2	Shelby clay loam, 14 to 18 percent slopes, moderately eroded-----	4,660	1.4
54	Zook silty clay loam, 0 to 2 percent slopes-----	4,800	1.4
54+	Zook silt loam, overwash, 0 to 2 percent slopes-----	1,560	0.5
54B	Zook silty clay loam, 2 to 5 percent slopes-----	970	0.3
65D	Lindley loam, 9 to 14 percent slopes-----	245	0.1
65E	Lindley loam, 14 to 18 percent slopes-----	1,935	0.6
65G	Lindley loam, 18 to 40 percent slopes-----	2,250	0.7
69C	Clearfield silty clay loam, 5 to 9 percent slopes-----	4,410	1.3
69C2	Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded-----	1,005	0.3
76C	Ladoga silt loam, 5 to 9 percent slopes-----	2,545	0.7
76C2	Ladoga silty clay loam, 5 to 9 percent slopes, moderately eroded-----	1,090	0.3
76D	Ladoga silt loam, 9 to 14 percent slopes-----	300	0.1
88	Nevin silty clay loam, 0 to 2 percent slopes-----	280	0.1
93D	Shelby-Adair clay loams, 9 to 14 percent slopes-----	655	0.2
93D2	Shelby-Adair clay loams, 9 to 14 percent slopes, moderately eroded-----	4,430	1.3
94D	Mystic-Caleb loams, 9 to 14 percent slopes-----	235	0.1
94D2	Mystic-Caleb complex, 9 to 14 percent slopes, moderately eroded-----	3,160	0.9
131B	Pershing silt loam, 2 to 5 percent slopes-----	225	0.1
131C	Pershing silt loam, 5 to 9 percent slopes-----	4,120	1.2
131C2	Pershing silty clay loam, 5 to 9 percent slopes, moderately eroded-----	3,835	1.1
131D	Pershing silt loam, 9 to 14 percent slopes-----	300	0.1
131D2	Pershing silty clay loam, 9 to 14 percent slopes, moderately eroded-----	250	0.1
132C	Weller silt loam, 5 to 9 percent slopes-----	400	0.1
172	Wabash silty clay, 0 to 2 percent slopes-----	2,075	0.6
172+	Wabash silt loam, overwash, 0 to 2 percent slopes-----	1,050	0.3
175C	Dickinson fine sandy loam, 5 to 9 percent slopes-----	185	0.1
175D	Dickinson fine sandy loam, 9 to 14 percent slopes-----	400	0.1
179D	Gara loam, 9 to 14 percent slopes-----	1,345	0.4
179D2	Gara loam, 9 to 14 percent slopes, moderately eroded-----	12,135	3.4
179D3	Gara clay loam, 9 to 14 percent slopes, severely eroded-----	225	0.1
179E	Gara loam, 14 to 18 percent slopes-----	1,970	0.6
179E2	Gara loam, 14 to 18 percent slopes, moderately eroded-----	18,500	5.3
179F	Gara loam, 18 to 25 percent slopes-----	2,135	0.6
179F2	Gara loam, 18 to 25 percent slopes, moderately eroded-----	2,030	0.6
192C	Adair clay loam, 5 to 9 percent slopes-----	1,440	0.4
192C2	Adair clay loam, 5 to 9 percent slopes, moderately eroded-----	10,915	3.2
192D2	Adair clay loam, 9 to 14 percent slopes, moderately eroded-----	2,275	0.7
211	Edina silt loam, 0 to 1 percent slopes-----	380	0.1
212	Kennebec silt loam, 0 to 2 percent slopes-----	2,595	0.8
220	Nodaway silt loam, 0 to 2 percent slopes-----	12,900	3.6
222C	Clarinda silty clay loam, 5 to 9 percent slopes-----	5,050	1.5
222C2	Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded-----	6,710	1.9
222D	Clarinda silty clay loam, 9 to 14 percent slopes-----	1,205	0.3
222D2	Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded-----	930	0.3
269	Humeston silty clay loam, 0 to 2 percent slopes-----	6,035	1.8
269+	Humeston silt loam, overwash, 0 to 2 percent slopes-----	625	0.2
269B	Humeston silty clay loam, 2 to 5 percent slopes-----	3,495	1.0
269B+	Humeston silt loam, overwash, 2 to 5 percent slopes-----	255	0.1
273B	Olmitz loam, 2 to 5 percent slopes-----	1,610	0.5
273C	Olmitz loam, 5 to 9 percent slopes-----	1,700	0.5
287B	Zook-Ely silty clay loams, 0 to 5 percent slopes-----	11,475	3.3
362	Haig silty clay loam, 0 to 2 percent slopes-----	1,620	0.5
364B	Grundy silty clay loam, 2 to 5 percent slopes-----	9,970	2.9
368B	Macksburg silty clay loam, 1 to 5 percent slopes-----	4,720	1.4
369	Winterset silty clay loam, 0 to 2 percent slopes-----	350	0.1
370B	Sharpsburg silty clay loam, 2 to 5 percent slopes-----	3,470	1.0
370C	Sharpsburg silty clay loam, 5 to 9 percent slopes-----	1,585	0.5
370C2	Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded-----	395	0.1
370D	Sharpsburg silty clay loam, 9 to 14 percent slopes-----	230	0.1

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
423C	Bucknell silty clay loam, 5 to 9 percent slopes-----	605	0.2
423C2	Bucknell silty clay loam, 5 to 9 percent slopes, moderately eroded-----	1,400	0.4
423D	Bucknell silty clay loam, 9 to 14 percent slopes-----	730	0.2
423D2	Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded-----	1,420	0.4
425C	Keswick silt loam, 5 to 9 percent slopes-----	375	0.1
425D	Keswick silt loam, 9 to 14 percent slopes-----	1,375	0.4
428B	Ely silty clay loam, 2 to 5 percent slopes-----	395	0.1
430	Ackmore silt loam, 0 to 2 percent slopes-----	2,370	0.7
451D2	Caleb loam, 9 to 14 percent slopes, moderately eroded-----	390	0.1
451F2	Caleb loam, 14 to 25 percent slopes, moderately eroded-----	225	0.1
452C	Lineville silt loam, 5 to 9 percent slopes-----	1,720	0.5
452C2	Lineville silt loam, 5 to 9 percent slopes, moderately eroded-----	1,725	0.5
470D	Lamoni-Shelby complex, 9 to 14 percent slopes-----	575	0.2
470D2	Lamoni-Shelby complex, 9 to 14 percent slopes, moderately eroded-----	2,175	0.6
534	Carlow silty clay, 0 to 2 percent slopes-----	500	0.1
534+	Carlow silt loam, overwash, 0 to 2 percent slopes-----	330	0.1
570C	Nira silty clay loam, 5 to 9 percent slopes-----	10,530	3.1
570C2	Nira silty clay loam, 5 to 9 percent slopes, moderately eroded-----	2,520	0.7
570D	Nira silty clay loam, 9 to 14 percent slopes-----	480	0.1
570D2	Nira silty clay loam, 9 to 14 percent slopes, moderately eroded-----	220	0.1
592C	Mystic loam, 5 to 9 percent slopes-----	200	0.1
592C2	Mystic clay loam, 5 to 9 percent slopes, moderately eroded-----	555	0.2
592D	Mystic loam, 9 to 14 percent slopes-----	920	0.3
592D2	Mystic clay loam, 9 to 14 percent slopes, moderately eroded-----	4,740	1.4
592E2	Mystic clay loam, 14 to 18 percent slopes, moderately eroded-----	285	0.1
792C	Armstrong loam, 5 to 9 percent slopes-----	2,075	0.6
792C2	Armstrong clay loam, 5 to 9 percent slopes, moderately eroded-----	13,380	3.8
792D	Armstrong loam, 9 to 14 percent slopes-----	1,260	0.4
792D2	Armstrong clay loam, 9 to 14 percent slopes, moderately eroded-----	10,530	3.1
822C	Lamoni silty clay loam, 5 to 9 percent slopes-----	2,290	0.7
822C2	Lamoni silty clay loam, 5 to 9 percent slopes, moderately eroded-----	10,560	3.1
822D	Lamoni silty clay loam, 9 to 14 percent slopes-----	3,425	1.0
822D2	Lamoni silty clay loam, 9 to 14 percent slopes, moderately eroded-----	4,815	1.4
831C2	Pershing silty clay loam, benches, 5 to 9 percent slopes, moderately eroded-----	200	0.1
870B	Sharpsburg silty clay loam, benches, 2 to 5 percent slopes-----	215	0.1
870C2	Sharpsburg silty clay loam, benches, 5 to 9 percent slopes, moderately eroded-----	260	0.1
993D	Gara-Armstrong loams, 9 to 14 percent slopes-----	300	0.1
993D2	Gara-Armstrong complex, 9 to 14 percent slopes, moderately eroded-----	3,160	0.9
1220	Nodaway silt loam, channeled, 0 to 2 percent slopes-----	1,710	0.5
5010	Pits, sand and gravel-----	40	*
5030	Pits, limestone quarries-----	180	0.1
5040	Orthents, loamy-----	420	0.1
	Water-----	835	0.2
	Sewage lagoons-----	165	*
	Total-----	344,320	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
13B	Olmitz-Zook-Humeston complex, 0 to 5 percent slopes (where drained)
54	Zook silty clay loam, 0 to 2 percent slopes (where drained)
54+	Zook silt loam, overwash, 0 to 2 percent slopes (where drained)
54B	Zook silty clay loam, 2 to 5 percent slopes (where drained)
88	Nevin silty clay loam, 0 to 2 percent slopes
131B	Pershing silt loam, 2 to 5 percent slopes
211	Edina silt loam, 0 to 1 percent slopes (where drained)
212	Kennebec silt loam, 0 to 2 percent slopes
220	Nodaway silt loam, 0 to 2 percent slopes
269	Humeston silty clay loam, 0 to 2 percent slopes (where drained)
269+	Humeston silt loam, overwash, 0 to 2 percent slopes (where drained)
269B	Humeston silty clay loam, 2 to 5 percent slopes (where drained)
269B+	Humeston silt loam, overwash, 2 to 5 percent slopes (where drained)
273B	Olmitz loam, 2 to 5 percent slopes
287B	Zook-Ely silty clay loams, 0 to 5 percent slopes (where drained)
362	Haig silty clay loam, 0 to 2 percent slopes (where drained)
364B	Grundy silty clay loam, 2 to 5 percent slopes
368B	Macksburg silty clay loam, 1 to 5 percent slopes
369	Winterset silty clay loam, 0 to 2 percent slopes (where drained)
370B	Sharpsburg silty clay loam, 2 to 5 percent slopes
428B	Ely silty clay loam, 2 to 5 percent slopes
430	Ackmore silt loam, 0 to 2 percent slopes (where drained)
870B	Sharpsburg silty clay loam, benches, 2 to 5 percent slopes

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
13B----- Olmitz-Zook-Humeston	IIIw	124	42	62	3.7	3.1	5.1	6.2
23C----- Arispe	IIIe	128	43	64	5.1	3.1	5.2	8.5
23C2----- Arispe	IIIe	124	42	62	5.0	3.1	5.1	8.4
24D----- Shelby	IIIe	119	40	60	5.0	2.9	4.9	8.4
24D2----- Shelby	IIIe	115	39	58	4.8	2.8	4.7	8.0
24E----- Shelby	IVe	102	34	51	4.3	2.5	4.2	7.2
24E2----- Shelby	IVe	98	33	49	4.1	2.4	4.0	6.9
54----- Zook	IIw	126	42	63	3.8	3.1	5.2	6.4
54+----- Zook	IIw	131	44	66	3.9	3.2	5.4	6.5
54B----- Zook	IIw	123	41	62	3.7	3.0	5.0	6.2
65D----- Lindley	IVe	101	34	51	4.2	2.5	4.1	7.0
65E----- Lindley	VIe	---	---	---	3.5	2.1	3.4	5.9
65G----- Lindley	VIIe	---	---	---	---	1.7	---	---
69C----- Clearfield	IIIw	112	38	56	3.4	2.8	4.6	5.7
69C2----- Clearfield	IIIw	108	36	54	3.2	2.7	4.4	5.3
76C----- Ladoga	IIIe	139	47	70	5.8	3.4	5.7	9.7
76C2----- Ladoga	IIIe	135	45	68	5.7	3.3	5.5	9.5
76D----- Ladoga	IIIe	130	44	65	5.5	3.2	5.3	9.2
88----- Nevin	I	153	51	77	6.1	3.8	6.3	10.2

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass- alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass- alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
93D----- Shelby-Adair	IVe	98	33	49	3.9	2.4	4.0	6.5
93D2----- Shelby-Adair	IVe	88	29	44	3.5	2.2	3.6	5.9
94D----- Mystic-Caleb	IVe	56	19	28	2.2	1.4	2.3	3.7
94D2----- Mystic-Caleb	IVe	46	15	23	1.8	1.1	1.9	3.0
131B----- Pershing	IIIe	119	40	60	4.8	2.9	4.9	8.0
131C----- Pershing	IIIe	114	38	57	4.6	2.8	4.7	7.7
131C2----- Pershing	IIIe	107	36	54	4.3	2.6	4.4	7.2
131D----- Pershing	IVe	105	35	53	4.2	2.6	4.3	7.0
131D2----- Pershing	IVe	98	33	49	3.9	2.4	4.0	6.5
132C----- Weller	IIIe	100	34	50	4.2	2.5	4.1	7.0
172----- Wabash	IIIw	84	28	42	2.5	2.1	3.4	4.2
172+----- Wabash	IIIw	100	34	50	3.0	2.5	4.1	5.0
175C----- Dickinson	IIIe	99	33	50	4.2	2.4	4.1	7.0
175D----- Dickinson	IVe	90	30	45	3.8	2.2	3.7	6.4
179D----- Gara	IVe	110	37	55	4.6	2.7	4.5	7.7
179D2----- Gara	IVe	106	36	53	4.5	2.6	4.3	7.5
179D3----- Gara	VIe	---	---	---	4.1	2.4	4.0	6.9
179E----- Gara	VIe	---	---	---	3.9	2.3	3.8	6.5
179E2----- Gara	VIe	---	---	---	3.7	2.2	3.6	6.2
179F----- Gara	VIe	---	---	---	3.5	2.0	3.4	5.9

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass- alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass- alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
179F2----- Gara	VIIE	---	---	---	---	1.9	---	2.0
192C----- Adair	IIIe	92	31	46	3.7	2.3	3.8	6.2
192C2----- Adair	IIIe	82	27	41	3.3	2.0	3.4	5.5
192D2----- Adair	IVe	73	24	37	2.9	1.8	3.0	4.8
211----- Edina	IIIw	107	36	54	3.2	2.6	4.4	5.3
212----- Kennebec	I	155	52	78	6.5	3.8	6.4	10.9
220----- Nodaway	IIw	145	49	73	6.1	3.6	5.9	10.2
222C----- Clarinda	IVw	82	27	41	2.5	2.0	3.4	4.2
222C2----- Clarinda	IVw	72	24	36	2.2	1.8	3.0	3.7
222D----- Clarinda	IVe	73	24	37	2.2	1.8	3.0	3.7
222D2----- Clarinda	IVe	63	21	32	1.9	1.5	2.6	3.2
269----- Humeston	IIIw	110	37	55	3.3	2.7	4.5	5.5
269+----- Humeston	IIIw	119	40	60	3.6	2.9	4.9	6.0
269B----- Humeston	IIIw	107	36	54	3.2	2.6	4.4	5.3
269B+----- Humeston	IIIw	116	39	58	3.5	2.9	4.8	5.9
273B----- Olmitz	IIe	137	46	69	5.8	3.4	5.6	9.7
273C----- Olmitz	IIIe	132	44	66	5.5	3.2	5.4	9.2
287B----- Zook-Ely	IIw	130	44	65	3.9	3.2	5.3	6.5
362----- Haig	IIw	131	44	66	3.9	3.2	5.4	6.5
364B----- Grundy	IIe	133	45	67	5.3	3.3	5.5	8.9

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass- alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass- alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
368B----- Macksburg	IIE	161	54	81	6.4	4.0	6.6	10.7
369----- Winterset	IIw	159	53	80	4.8	3.9	6.5	8.0
370B----- Sharpsburg	IIE	153	51	77	6.4	3.8	6.3	10.7
370C----- Sharpsburg	IIIe	148	50	74	6.2	3.6	6.1	10.4
370C2----- Sharpsburg	IIIe	144	48	72	6.0	3.5	5.9	10.0
370D----- Sharpsburg	IIIe	139	47	70	5.8	3.4	5.7	9.7
423C----- Bucknell	IIIe	83	28	42	3.3	2.0	3.4	5.5
423C2----- Bucknell	IIIe	73	24	37	2.9	1.8	3.0	4.8
423D----- Bucknell	IVe	74	25	37	3.0	1.8	3.0	5.0
423D2----- Bucknell	IVe	64	21	32	2.6	1.6	2.6	4.3
425C----- Keswick	IIIe	74	25	37	3.1	1.8	3.0	5.2
425D----- Keswick	IVe	65	22	33	2.7	1.6	2.7	4.5
428B----- Ely	IIE	149	50	75	6.0	3.7	6.1	10.0
430----- Ackmore	IIw	141	47	71	4.2	3.5	5.8	7.0
451D2----- Caleb	IVe	83	28	42	3.5	2.0	3.4	5.9
451F2----- Caleb	VIIe	---	---	---	---	1.4	---	---
452C----- Lineville	IIIe	92	31	46	3.7	2.3	3.8	6.2
452C2----- Lineville	IIIe	85	28	43	3.4	2.1	3.5	5.7
470D----- Lamoni-Shelby	IVe	92	31	46	3.7	2.3	3.8	6.2
470D2----- Lamoni-Shelby	IVe	82	27	41	3.3	2.0	3.4	5.5

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass- alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass- alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
534----- Carlow	IIIw	82	27	41	2.5	2.0	3.4	4.2
534+----- Carlow	IIIw	90	30	45	2.7	2.2	3.7	4.5
570C----- Nira	IIIe	143	48	72	6.0	3.5	5.9	10.0
570C2----- Nira	IIIe	139	47	70	5.8	3.4	5.7	9.7
570D----- Nira	IIIe	134	45	67	5.6	3.3	5.5	9.4
570D2----- Nira	IIIe	130	44	65	5.5	3.2	5.3	9.2
592C----- Mystic	IIIe	75	25	38	3.0	3.1	3.1	5.0
592C2----- Mystic	IIIe	65	22	33	2.6	1.6	2.7	4.3
592D----- Mystic	IVe	66	22	33	2.6	1.6	2.7	4.3
592D2----- Mystic	IVe	56	19	28	2.2	1.4	2.3	3.7
592E2----- Mystic	VIe	---	---	---	1.6	1.0	1.6	2.7
792C----- Armstrong	IIIe	83	28	42	3.3	2.0	3.4	5.5
792C2----- Armstrong	IIIe	73	24	37	2.9	1.8	3.0	4.8
792D----- Armstrong	IVe	74	25	37	3.0	1.8	3.0	5.0
792D2----- Armstrong	IVe	64	21	32	2.6	1.6	2.6	4.3
822C----- Lamoni	IIIe	92	31	46	3.7	2.3	3.8	6.2
822C2----- Lamoni	IIIe	82	27	41	3.3	2.0	3.4	5.5
822D----- Lamoni	IVe	83	28	42	3.3	2.0	3.4	5.5
822D2----- Lamoni	IVe	73	24	37	2.9	1.8	3.0	4.8
831C2----- Pershing	IIIe	107	36	54	4.3	2.6	4.4	7.2

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass- alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass- alfalfa
		Bu	Bu	Bu	Tons	AUM*	AUM*	AUM*
870B----- Sharpsburg	IIe	153	51	77	6.4	3.8	6.3	10.7
870C2----- Sharpsburg	IIIe	144	48	72	6.0	3.5	5.9	10.3
993D----- Gara-Armstrong	IVe	96	32	48	3.8	2.4	3.9	6.4
993D2----- Gara-Armstrong	IVe	86	29	43	3.4	2.1	3.5	5.7
1220----- Nodaway	Vw	---	---	---	---	---	---	---
5010**, 5030**. Pits								
5040**. Orthents								

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
65D----- Lindley	3A	Slight	Slight	Slight	Slight	White oak----- Post oak----- Blackjack oak----- Black oak----- White oak----- Post oak-----	60 --- --- --- --- ---	3 --- --- --- --- ---	White oak, green ash, black oak, northern red oak.
65E, 65G----- Lindley	3R	Moderate	Moderate	Slight	Slight	White oak----- Post oak----- Blackjack oak----- Black oak----- White oak----- Post oak-----	60 --- --- --- --- ---	3 --- --- --- --- ---	White oak, green ash, black oak, northern red oak.
76C, 76C2, 76D-- Ladoga	4A	Slight	Slight	Slight	Slight	White oak----- Northern red oak----	75 75	4 4	Eastern white pine, red pine, white oak, sugar maple, northern red oak, European larch, black walnut.
94D**, 94D2**: Mystic-----	3A	Slight	Slight	Slight	Slight	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, black walnut, sugar maple.
Caleb-----	3A	Slight	Slight	Slight	Slight	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, black walnut, sugar maple.
131B, 131C, 131C2, 131D, 131D2----- Pershing	3C	Slight	Slight	Severe	Severe	White oak-----	55	3	Eastern white pine, white oak, red pine.
132C----- Weller	3C	Slight	Slight	Severe	Severe	White oak-----	55	3	Eastern white pine, red pine, black walnut, sugar maple.
172----- Wabash	4W	Slight	Severe	Severe	Moderate	Pin oak-----	75	4	Pin oak, pecan, eastern cottonwood.
172+----- Wabash	4W	Slight	Severe	Moderate	Moderate	Pin oak-----	75	4	Pin oak, pecan, eastern cottonwood.

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
179D, 179D2----- Gara	3A	Slight	Slight	Slight	Slight	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, white oak, northern red oak.
179D3----- Gara	3A	Slight	Slight	Slight	Slight	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, white oak.
179E, 179E2, 179F, 179F2----- Gara	3R	Moderate	Moderate	Slight	Slight	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, white oak, northern red oak.
212----- Kennebec	3A	Slight	Slight	Slight	Slight	Bur oak----- Black walnut----- Hackberry----- Green ash----- Eastern cottonwood--	63 79 --- --- ---	3 --- --- --- ---	Black walnut, bur oak, hackberry, green ash, eastern cottonwood, American sycamore.
220----- Nodaway	3A	Slight	Slight	Slight	Slight	White oak-----	65	3	Eastern white pine, red pine, black walnut, sugar maple, European larch.
423C, 423C2, 423D, 423D2----- Bucknell	2C	Slight	Slight	Slight	Moderate	White oak----- Northern red oak----	50 50	2 2	Silver maple, American sycamore, green ash, hackberry, eastern redcedar.
425C, 425D----- Keswick	3C	Slight	Slight	Moderate	Severe	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, sugar maple.
430----- Ackmore	3A	Slight	Slight	Slight	Slight	White oak-----	65	3	Eastern white pine, red pine, cottonwood, sugar maple, black walnut.

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
451D2----- Caleb	3A	Slight	Slight	Slight	Slight	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, black walnut, sugar maple.
451F2----- Caleb	3R	Moderate	Moderate	Slight	Slight	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, black walnut, sugar maple.
452C, 452C2----- Lineville	3A	Slight	Slight	Slight	Slight	White oak-----	55	3	Eastern white pine, red pine, Norway spruce, white spruce, sugar maple.
534, 534+----- Carlow	4W	Slight	Severe	Severe	Moderate	Pin oak----- Eastern cottonwood--	75 85	4 6	Eastern cottonwood, pin oak, pecan, green ash, sweetgum, willow oak, baldcypress, silver maple.
592C, 592C2, 592D, 592D2----- Mystic	3A	Slight	Slight	Slight	Slight	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, black walnut, sugar maple.
592E2----- Mystic	3R	Slight	Moderate	Slight	Slight	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, black walnut, sugar maple.
792C, 792C2, 792D, 792D2----- Armstrong	3C	Slight	Slight	Moderate	Severe	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, European larch, sugar maple.
831C2----- Pershing	3C	Slight	Slight	Severe	Severe	White oak-----	55	3	Eastern white pine, white oak, red pine.
993D**, 993D2**: Gara-----	3A	Slight	Slight	Slight	Slight	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, white oak, northern red oak.

See footnotes at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
993D**, 993D2**: Armstrong-----	3C	Slight	Slight	Moderate	Severe	White oak----- Northern red oak----	55 55	3 3	Eastern white pine, red pine, European larch, sugar maple.
1220----- Nodaway	3A	Slight	Slight	Slight	Slight	White oak-----	65	3	Eastern white pine, red pine, black walnut, sugar maple, European larch.

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
13B*: Olmitz-----	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.
Zook-----	---	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	Norway spruce, northern whitecedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Humeston-----	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
23C, 23C2----- Arispe	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
24D, 24D2, 24E, 24E2----- Shelby	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern whitecedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
54, 54+----- Zook	---	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	Norway spruce, northern whitecedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
54B----- Zook	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, white fir, blue spruce, northern whitecedar, Austrian pine, Norway spruce.	Eastern white pine	Pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
65D, 65E, 65G----- Lindley	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern whitecedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
69C, 69C2----- Clearfield	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, blue spruce, white fir, northern whitecedar, Washington hawthorn, Norway spruce.	Eastern white pine	Pin oak.
76C, 76C2, 76D----- Ladoga	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
88----- Nevin	---	Silky dogwood, Amur privet, American cranberrybush, Amur honeysuckle.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
93D*, 93D2*: Shelby-----	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern whitecedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
Adair-----	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
94D*, 94D2*: Mystic-----	---	American cranberrybush, Amur honeysuckle, eastern redcedar, arrowwood, Amur privet, Washington hawthorn.	Osageorange, green ash, Austrian pine.	Eastern white pine, pin oak.	---
Caleb-----	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
131B, 131C, 131C2, 131D, 131D2----- Pershing	---	Eastern redcedar, American cranberrybush, Washington hawthorn, Amur privet, Amur honeysuckle, arrowwood.	Austrian pine, Osageorange, green ash.	Eastern white pine, pin oak.	---
132C----- Weller	---	American cranberrybush, Amur honeysuckle, arrowwood, Washington hawthorn, Amur privet, eastern redcedar.	Osageorange, green ash, Austrian pine.	Eastern white pine, pin oak.	---
172, 172+----- Wabash	---	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
175C, 175D----- Dickinson	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn olive, Amur honeysuckle, lilac.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
179D, 179D2, 179D3, 179E, 179E2, 179F, 179F2----- Gara	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Northern whitecedar, white fir, Washington hawthorn, blue spruce.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
192C, 192C2, 192D2----- Adair	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
211----- Edina	---	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, northern whitecedar, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
212----- Kennebec	---	Amur maple, Amur honeysuckle, lilac, autumn olive.	Eastern redcedar	Austrian pine, hackberry, pin oak, green ash, honeylocust.	Eastern white pine, eastern cottonwood.
220----- Nodaway	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
222C, 222C2, 222D, 222D2----- Clarinda	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Green ash, Osageorange.	Eastern white pine, pin oak, Austrian pine.	---
269, 269+, 269B, 269B+----- Humeston	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
273B, 273C----- Olmitz	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.
287B*: Zook-----	---	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	Norway spruce, northern whitecedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Ely-----	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
362----- Haig	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, blue spruce, white fir, northern whitecedar, Washington hawthorn.	Eastern white pine	Pin oak.
364B----- Grundy	---	Washington hawthorn, eastern redcedar, Amur honeysuckle, Amur privet, American cranberrybush, arrowwood.	Austrian pine, Osageorange, green ash.	Pin oak, eastern white pine.	---
368B----- Macksburg	---	American cranberrybush, Amur honeysuckle, Amur privet, silky dogwood.	Northern whitecedar, blue spruce, Washington hawthorn, white fir, Austrian pine.	Norway spruce-----	Eastern white pine, pin oak.
369----- Winterset	---	American cranberrybush, Amur privet, silky dogwood, Amur honeysuckle.	Austrian pine, Washington hawthorn, blue spruce, northern whitecedar, white fir, Norway spruce.	Eastern white pine	Pin oak.
370B, 370C, 370C2, 370D----- Sharpsburg	---	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
423C, 423C2, 423D, 423D2----- Bucknell	---	American cranberrybush, eastern redcedar, arrowwood, Washington hawthorn, Amur privet, Amur honeysuckle.	Green ash, Austrian pine, Osageorange.	Eastern white pine, pin oak.	---
425C, 425D----- Keswick	---	Eastern redcedar, American cranberrybush, Washington hawthorn, arrowwood, Amur privet, Amur honeysuckle.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
428B----- Ely	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
430----- Ackmore	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
451D2, 451F2----- Caleb	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
452C, 452C2----- Lineville	---	Eastern redcedar, American cranberrybush, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle.	Austrian pine, Osageorange, green ash.	Eastern white pine, pin oak.	---
470D*, 470D2*: Lamoni-----	---	Eastern redcedar, Washington hawthorn, arrowwood, Amur honeysuckle, Amur privet, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
Shelby-----	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern whitecedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
534, 534+----- Carlow	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Washington hawthorn, white fir, blue spruce, northern whitecedar, Austrian pine, Norway spruce.	Eastern white pine	Pin oak.
570C, 570C2, 570D, 570D2----- Nira	---	Amur honeysuckle, silky dogwood, Amur privet, American cranberrybush.	White fir, blue spruce, Washington hawthorn, northern whitecedar.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
592C, 592C2, 592D, 592D2, 592E2----- Mystic	---	American cranberrybush, Amur honeysuckle, eastern redcedar, arrowwood, Amur privet, Washington hawthorn.	Osageorange, green ash, Austrian pine.	Eastern white pine, pin oak.	---
792C, 792C2, 792D, 792D2----- Armstrong	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush, Amur honeysuckle.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
822C, 822C2, 822D, 822D2----- Lamoni	---	Eastern redcedar, Washington hawthorn, arrowwood, Amur honeysuckle, Amur privet, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
831C2----- Pershing	---	Eastern redcedar, American cranberrybush, Washington hawthorn, Amur privet, Amur honeysuckle, arrowwood.	Austrian pine, Osageorange, green ash.	Eastern white pine, pin oak.	---
870B, 870C2----- Sharpsburg	---	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
993D*, 993D2*: Gara-----	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Northern whitecedar, white fir, Washington hawthorn, blue spruce.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
Armstrong-----	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush, Amur honeysuckle.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1220----- Nodaway	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
13B*: Olmitz-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Zook-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Humeston-----	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
23C, 23C2----- Arispe	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight-----	Slight.
24D, 24D2----- Shelby	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.
24E, 24E2----- Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
54, 54+----- Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
54B----- Zook	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
65D----- Lindley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.
65E----- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
65G----- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
69C, 69C2----- Clearfield	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
76C, 76C2----- Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight.
76D----- Ladoga	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.
88----- Nevin	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight-----	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
93D*, 93D2*: Shelby-----	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.
Adair-----	Severe: wetness.	Moderate: slope, wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
94D*, 94D2*: Mystic-----	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Caleb-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
131B----- Pershing	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight-----	Slight.
131C, 131C2----- Pershing	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight-----	Slight.
131D, 131D2----- Pershing	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
132C----- Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight-----	Slight.
172----- Wabash	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
172+----- Wabash	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.
175C----- Dickinson	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
175D----- Dickinson	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
179D, 179D2----- Gara	Moderate: percs slowly, slope.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.
179D3----- Gara	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
179E, 179E2, 179F, 179F2----- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
192C, 192C2----- Adair	Severe: wetness.	Moderate: wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
192D2----- Adair	Severe: wetness.	Moderate: slope, wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
211----- Edina	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
212----- Kennebec	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
220----- Nodaway	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
222C, 222C2----- Clarinda	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
222D, 222D2----- Clarinda	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
269, 269+, 269B, 269B+----- Humeston	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
273B----- Olmitz	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
273C----- Olmitz	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
287B*: Zook-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Ely-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight-----	Slight.
362----- Haig	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
364B----- Grundy	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Moderate: wetness.	Moderate: wetness.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
368B----- Macksburg	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Moderate: slope, wetness, percs slowly.	Slight-----	Slight.
369----- Winterset	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
370B----- Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight-----	Slight.
370C, 370C2----- Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight.
370D----- Sharpsburg	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.
423C, 423C2----- Bucknell	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
423D, 423D2----- Bucknell	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
425C----- Keswick	Severe: wetness.	Moderate: wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
425D----- Keswick	Severe: wetness.	Moderate: slope, wetness.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
428B----- Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight-----	Slight.
430----- Ackmore	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
451D2----- Caleb	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
451F2----- Caleb	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
452C, 452C2----- Lineville	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
470D*, 470D2*: Lamoni-----	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
470D*, 470D2*: Shelby-----	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.
534----- Carlow	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
534+----- Carlow	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.
570C, 570C2----- Nira	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
570D, 570D2----- Nira	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
592C, 592C2----- Mystic	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight.
592D, 592D2----- Mystic	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
592E2----- Mystic	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
792C, 792C2----- Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
792D, 792D2----- Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
822C, 822C2----- Lamoni	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
822D, 822D2----- Lamoni	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
831C2----- Pershing	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight-----	Slight.
870B----- Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight-----	Slight.
870C2----- Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
993D*, 993D2*: Gara-----	Moderate: percs slowly, slope.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: slope.
Armstrong-----	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
1220----- Nodaway	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
13B*:										
Olmitz-----	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
Zook-----	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Humeston-----	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
23C, 23C2-----	Good	Good	Good	Good	Good	Very poor.	Poor	Good	Good	Very poor.
Arispe										
24D, 24D2-----	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Shelby										
24E, 24E2-----	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Shelby										
54, 54+, 54B-----	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Zook										
65D-----	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Lindley										
65E-----	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Lindley										
65G-----	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Lindley										
69C, 69C2-----	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
Clearfield										
76C, 76C2, 76D-----	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
Ladoga										
88-----	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Nevin										
93D*, 93D2*:										
Shelby-----	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Adair-----	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
94D*, 94D2*:										
Mystic-----	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
Caleb-----	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.
131B-----	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
Pershing										

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
131C, 131C2----- Pershing	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
131D, 131D2----- Pershing	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
132C----- Weller	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
172----- Wabash	Poor	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
172+----- Wabash	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
175C, 175D----- Dickinson	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
179D, 179D2, 179D3- Gara	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
179E, 179E2, 179F, 179F2----- Gara	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
192C, 192C2, 192D2- Adair	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
211----- Edina	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
212----- Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
220----- Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
222C, 222C2, 222D, 222D2----- Clarinda	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
269, 269+, 269B, 269B+----- Humeston	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
273B----- Olmitz	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
273C----- Olmitz	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
287B*: Zook----- Ely-----	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
362----- Haig	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
364B----- Grundy	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
368B----- Macksburg	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
369----- Winterset	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
370B----- Sharpsburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
370C, 370C2, 370D-- Sharpsburg	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
423C, 423C2, 423D, 423D2----- Bucknell	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Very poor.
425C, 425D----- Keswick	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
428B----- Ely	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
430----- Ackmore	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
451D2----- Caleb	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.
451F2----- Caleb	Poor	Good	Fair	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.
452C, 452C2----- Lineville	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.
470D*, 470D2*: Lamoni-----	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
Shelby-----	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
534, 534+----- Carlow	Poor	Poor	Fair	Fair	Fair	Poor	Good	Poor	Fair	Fair.
570C, 570C2, 570D, 570D2----- Nira	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
592C, 592C2, 592D, 592D2----- Mystic	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
592E2----- Mystic	Poor	Fair	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
792C, 792C2, 792D, 792D2----- Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
822C, 822C2, 822D, 822D2----- Lamoni	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
831C2----- Pershing	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
870B----- Sharpsburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
870C2----- Sharpsburg	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
993D*, 993D2*: Gara-----	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
Armstrong-----	Fair	Good	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
1220----- Nodaway	Poor	Fair	Fair	Poor	Poor	Good	Fair	Poor	Poor	Fair.
5010*, 5030*. Pits										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
13B*: Olmitz-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Zook-----	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
Humeston-----	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, wetness, low strength.	Severe: wetness.
23C, 23C2----- Arispe	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
24D, 24D2----- Shelby	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
24E, 24E2----- Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
54, 54+----- Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
54B----- Zook	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
65D----- Lindley	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
65E, 65G----- Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
69C, 69C2----- Clearfield	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
76C, 76C2----- Ladoga	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
76D----- Ladoga	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
88----- Nevin	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Slight.
93D*, 93D2*: Shelby-----	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Adair-----	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
94D*, 94D2*: Mystic-----	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
Caleb-----	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
131B, 131C, 131C2- Pershing	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
131D, 131D2----- Pershing	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, frost action.	Moderate: slope.
132C----- Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Slight.
172----- Wabash	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, too clayey.
172+----- Wabash	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
175C----- Dickinson	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.
175D----- Dickinson	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
179D, 179D2----- Gara	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
179D3----- Gara	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
179E, 179E2, 179F, 179F2----- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
192C, 192C2----- Adair	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
192D2----- Adair	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
211----- Edina	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
212----- Kennebec	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
220----- Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
222C, 222C2----- Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
222D, 222D2----- Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: wetness, slope.
269, 269+, 269B, 269B+----- Humeston	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, wetness, low strength.	Severe: wetness.
273B----- Olmitz	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
273C----- Olmitz	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
287B*: Zook-----	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
Ely-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Slight.
362----- Haig	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
364B----- Grundy	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
368B----- Macksburg	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
369----- Winterset	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
370B----- Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
370C, 370C2----- Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
370D----- Sharpsburg	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
423C, 423C2----- Bucknell	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
423D, 423D2----- Bucknell	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
425C----- Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
425D----- Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
428B----- Ely	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Slight.
430----- Ackmore	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
451D2----- Caleb	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
451F2----- Caleb	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
452C, 452C2----- Lineville	Severe: wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
470D*, 470D2*: Lamoni-----	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
Shelby-----	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
534----- Carlow	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, too clayey.
534+----- Carlow	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
570C, 570C2----- Nira	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
570D, 570D2----- Nira	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
592C, 592C2----- Mystic	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
592D, 592D2----- Mystic	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
592E2----- Mystic	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
792C, 792C2----- Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength.	Moderate: wetness.
792D, 792D2----- Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: slope, wetness.
822C, 822C2----- Lamoni	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength.	Moderate: wetness.
822D, 822D2----- Lamoni	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
831C2----- Pershing	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
870B----- Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
870C2----- Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
993D*, 993D2*: Gara-----	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Armstrong-----	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: slope, wetness.
1220----- Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Severe: flooding.
5010*, 5030*. Pits						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
13B*: Olmitz-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Zook-----	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Humeston-----	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey, hard to pack.
23C, 23C2----- Arispe	Severe: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness, too clayey.	Moderate: wetness.	Poor: hard to pack.
24D, 24D2----- Shelby	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
24E, 24E2----- Shelby	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
54, 54+----- Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
54B----- Zook	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
65D----- Lindley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
65E, 65G----- Lindley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
69C, 69C2----- Clearfield	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness, hard to pack.
76C, 76C2----- Ladoga	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
76D----- Ladoga	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
88----- Nevin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
93D*, 93D2*: Shelby-----	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
Adair-----	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
94D*, 94D2*: Mystic-----	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
Caleb-----	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness, slope, too clayey.	Moderate: slope.	Fair: too clayey, slope, wetness.
131B----- Pershing	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
131C, 131C2----- Pershing	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
131D, 131D2----- Pershing	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness, slope.	Poor: too clayey, hard to pack.
132C----- Weller	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
172, 172+----- Wabash	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
175C, 175D----- Dickinson	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
179D, 179D2----- Gara	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
179D3----- Gara	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
179E, 179E2, 179F, 179F2----- Gara	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
192C, 192C2, 192D2-- Adair	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
211----- Edina	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
212----- Kennebec	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
220----- Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
222C, 222C2, 222D, 222D2----- Clarinda	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
269, 269+----- Humeston	Severe: wetness, percs slowly, flooding.	Severe: flooding.	Severe: wetness, too clayey, flooding.	Severe: wetness, flooding.	Poor: wetness, too clayey, hard to pack.
269B, 269B+----- Humeston	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey, hard to pack.
273B----- Olmitz	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
273C----- Olmitz	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
287B*: Zook-----	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Ely-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
362----- Haig	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
364B----- Grundy	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
368B----- Macksburg	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
369----- Winterset	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
370B----- Sharpsburg	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
370C, 370C2----- Sharpsburg	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
370D----- Sharpsburg	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
423C, 423C2, 423D, 423D2----- Bucknell	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
425C, 425D----- Keswick	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
428B----- Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
430----- Ackmore	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness, hard to pack.
451D2----- Caleb	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness, slope, too clayey.	Moderate: slope.	Fair: too clayey, slope, wetness.
451F2----- Caleb	Severe: wetness, slope.	Severe: slope, wetness.	Severe: slope.	Severe: slope.	Poor: slope.
452C, 452C2----- Lineville	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
470D*, 470D2*: Lamoni-----	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
Shelby-----	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
534, 534+----- Carlow	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
570C, 570C2----- Nira	Moderate: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Moderate: wetness.	Poor: hard to pack.
570D, 570D2----- Nira	Moderate: wetness, percs slowly, slope.	Severe: slope.	Severe: wetness.	Moderate: wetness, slope.	Poor: hard to pack.
592C, 592C2----- Mystic	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, too clayey.	Slight-----	Poor: too clayey, hard to pack.
592D, 592D2----- Mystic	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
592E2----- Mystic	Severe: wetness, percs slowly, slope.	Severe: seepage, slope.	Severe: seepage, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
792C, 792C2, 792D, 792D2----- Armstrong	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
822C, 822C2, 822D, 822D2----- Lamoni	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
831C2----- Pershing	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
870B----- Sharpsburg	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
870C2----- Sharpsburg	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
993D*, 993D2*: Gara-----	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
Armstrong-----	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
1220----- Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
13B*: Olmitz-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Zook-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Humeston-----	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
23C, 23C2----- Arispe	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
24D, 24D2----- Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
24E, 24E2----- Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
54, 54+----- Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
54B----- Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
65D----- Lindley	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
65E----- Lindley	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
65G----- Lindley	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
69C, 69C2----- Clearfield	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
76C, 76C2, 76D----- Ladoga	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
88----- Nevin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
93D*, 93D2*: Shelby-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Adair-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
94D*, 94D2*: Mystic-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, too clayey.
Caleb-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
131B, 131C----- Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
131C2----- Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
131D----- Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
131D2----- Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
132C----- Weller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
172, 172+----- Wabash	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
175C----- Dickinson	Good-----	Probable-----	Improbable: too sandy.	Good.
175D----- Dickinson	Good-----	Probable-----	Improbable: too sandy.	Fair: slope.
179D----- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
179D2----- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope, small stones.
179D3----- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
179E, 179E2, 179F, 179F2----- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
192C, 192C2, 192D2---- Adair	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
211----- Edina	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
212----- Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
220----- Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
222C, 222C2, 222D, 222D2----- Clarinda	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
269, 269+, 269B, 269B+----- Humeston	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
273B, 273C----- Olmitz	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
287B*: Zook-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Ely-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
362----- Haig	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
364B----- Grundy	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
368B----- Macksburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
369----- Winterset	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
370B, 370C, 370C2, 370D----- Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
423C, 423C2, 423D, 423D2----- Bucknell	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
425C, 425D----- Keswick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
428B----- Ely	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
430----- Ackmore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
451D2----- Caleb	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
451F2----- Caleb	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
452C, 452C2----- Lineville	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.
470D*, 470D2*: Lamoni-----	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Shelby-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
534, 534+----- Carlow	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
570C, 570C2----- Nira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
570D, 570D2----- Nira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
592C, 592C2, 592D, 592D2----- Mystic	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, too clayey.
592E2----- Mystic	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, too clayey, slope.
792C, 792C2, 792D, 792D2----- Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
822C, 822C2, 822D, 822D2----- Lamoni	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
831C2----- Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
870B, 870C2----- Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
993D*: Gara-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
Armstrong-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
993D2*: Gara-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope, small stones.
Armstrong-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1220----- Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
5010*, 5030*. Pits				
5040*. Orthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
13B*: Olmitz-----	Moderate: seepage, slope.	Slight-----	Severe: no water.	Deep to water	Favorable-----	Favorable.
Zook-----	Slight-----	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
Humeston-----	Moderate: seepage, slope.	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Percs slowly, wetness.
23C, 23C2----- Arispe	Moderate: seepage, slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
24D, 24D2, 24E, 24E2----- Shelby	Severe: slope.	Slight-----	Severe: no water.	Deep to water	Slope-----	Slope.
54, 54+----- Zook	Slight-----	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
54B----- Zook	Moderate: slope.	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Wetness, percs slowly.	Wetness, percs slowly.
65D, 65E, 65G----- Lindley	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Slope.
69C, 69C2----- Clearfield	Moderate: slope.	Moderate: thin layer, hard to pack, wetness.	Severe: no water.	Frost action, slope.	Wetness, erodes easily.	Wetness, erodes easily.
76C, 76C2----- Ladoga	Moderate: seepage, slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
76D----- Ladoga	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
88----- Nevin	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action---	Erodes easily, wetness.	Erodes easily.
93D*, 93D2*: Shelby-----	Severe: slope.	Slight-----	Severe: no water.	Deep to water	Slope-----	Slope.
Adair-----	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness.	Wetness, slope, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
94D*, 94D2*: Mystic-----	Severe: slope, seepage.	Moderate: thin layer, hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Caleb-----	Severe: slope.	Moderate: thin layer.	Severe: no water.	Deep to water	Slope-----	Slope, rooting depth.
131B, 131C, 131C2- Pershing	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, erodes easily.	Erodes easily, percs slowly.
131D, 131D2----- Pershing	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, erodes easily.	Slope, erodes easily, percs slowly.
132C----- Weller	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Slope, percs slowly, frost action.	Wetness, erodes easily.	Percs slowly, erodes easily.
172----- Wabash	Slight-----	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
172+----- Wabash	Slight-----	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding.	Wetness, percs slowly.	Wetness, percs slowly.
175C----- Dickinson	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Favorable.
175D----- Dickinson	Severe: slope, seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope.
179D, 179D2----- Gara	Severe: slope.	Slight-----	Severe: no water.	Deep to water	Slope-----	Slope.
179D3----- Gara	Severe: slope.	Slight-----	Severe: no water.	Deep to water	Slope-----	Slope, rooting depth.
179E, 179E2, 179F, 179F2----- Gara	Severe: slope.	Slight-----	Severe: no water.	Deep to water	Slope-----	Slope.
192C, 192C2----- Adair	Moderate: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Wetness-----	Wetness, percs slowly.
192D2----- Adair	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness.	Wetness, slope, percs slowly.
211----- Edina	Slight-----	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly---	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
212----- Kennebec	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable-----	Favorable.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
220----- Nodaway	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
222C, 222C2----- Clarinda	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Wetness, erodes easily.
222D, 222D2----- Clarinda	Severe: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
269, 269+----- Humeston	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action, flooding.	Wetness, percs slowly.	Percs slowly, wetness.
269B, 269B+----- Humeston	Moderate: seepage, slope.	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Percs slowly, wetness.
273B, 273C----- Olmitz	Moderate: seepage, slope.	Slight-----	Severe: no water.	Deep to water	Favorable-----	Favorable.
287B*: Zook-----	Slight-----	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.
Ely-----	Moderate: slope, seepage.	Moderate: wetness, piping.	Moderate: deep to water, slow refill.	Slope, frost action.	Erodes easily, wetness.	Erodes easily.
362----- Haig	Slight-----	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
364B----- Grundy	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
368B----- Macksburg	Moderate: seepage, slope.	Moderate: wetness.	Severe: slow refill.	Frost action, slope.	Erodes easily, wetness.	Erodes easily.
369----- Winterset	Slight-----	Severe: wetness.	Severe: slow refill.	Frost action---	Erodes easily, wetness.	Wetness, erodes easily.
370B, 370C, 370C2----- Sharpsburg	Moderate: seepage, slope.	Slight-----	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
370D----- Sharpsburg	Severe: slope.	Slight-----	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
423C, 423C2----- Bucknell	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Wetness, percs slowly.	Wetness, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
423D, 423D2----- Bucknell	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness, percs slowly.	Wetness, slope, percs slowly.
425C----- Keswick	Moderate: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Wetness, erodes easily.
425D----- Keswick	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
428B----- Ely	Moderate: slope, seepage.	Moderate: wetness, piping.	Moderate: deep to water, slow refill.	Slope, frost action.	Erodes easily, wetness.	Erodes easily.
430----- Ackmore	Moderate: seepage.	Severe: hard to pack, wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, erodes easily.	Wetness, erodes easily.
451D2, 451F2----- Caleb	Severe: slope.	Moderate: thin layer.	Severe: no water.	Deep to water	Slope-----	Slope, rooting depth.
452C, 452C2----- Lineville	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Erodes easily, wetness.	Wetness, erodes easily.
470D*, 470D2*: Lamoni-----	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.
Shelby-----	Severe: slope.	Slight-----	Severe: no water.	Deep to water	Slope-----	Slope.
534----- Carlow	Slight-----	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, droughty.
534+----- Carlow	Slight-----	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily.
570C, 570C2----- Nira	Moderate: seepage, slope.	Moderate: hard to pack.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
570D, 570D2----- Nira	Severe: slope.	Moderate: hard to pack.	Moderate: deep to water, slow refill.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
592C, 592C2----- Mystic	Severe: seepage.	Moderate: thin layer, hard to pack.	Severe: no water.	Deep to water	Erodes easily, percs slowly.	Erodes easily, percs slowly.
592D, 592D2, 592E2----- Mystic	Severe: slope, seepage.	Moderate: thin layer, hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
792C, 792C2----- Armstrong	Moderate: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Slope, percs slowly, frost action.	Percs slowly, wetness.	Percs slowly, wetness.
792D, 792D2----- Armstrong	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Slope, percs slowly, frost action.	Slope, percs slowly, wetness.	Percs slowly, slope, wetness.
822C, 822C2----- Lamoni	Moderate: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly, slope.	Percs slowly, wetness.	Percs slowly, wetness.
822D, 822D2----- Lamoni	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.
831C2----- Pershing	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, erodes easily.	Erodes easily, percs slowly.
870B, 870C2----- Sharpsburg	Moderate: seepage, slope.	Slight-----	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
993D*, 993D2*: Gara-----	Severe: slope.	Slight-----	Severe: no water.	Deep to water	Slope-----	Slope.
Armstrong-----	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Slope, percs slowly, frost action.	Slope, percs slowly, wetness.	Percs slowly, slope, wetness.
1220----- Nodaway	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
5010*, 5030*. Pits						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
13B*: Olmitz-----	0-28	Loam-----	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
	28-60	Loam, clay loam	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
Zook-----	0-16	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	16-50	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	50-60	Silty clay loam, silty clay, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	95-100	35-80	10-50
Humeston-----	0-11	Silty clay loam	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
	11-25	Silt loam-----	CL, CL-ML	A-6, A-4	0	100	100	95-100	95-100	25-40	5-15
	25-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	45-55	25-35
23C, 23C2----- Arispe	0-10	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	20-30
	10-48	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-60	25-35
	48-60	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	20-30
24D, 24D2, 24E, 24E2----- Shelby	0-12	Clay loam-----	CL	A-6, A-7	0	90-95	85-95	75-90	55-70	35-45	15-25
	12-38	Clay loam-----	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	38-60	Clay loam-----	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
54----- Zook	0-16	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	16-50	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	50-60	Silty clay loam, silty clay, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	95-100	35-80	10-50
54+----- Zook	0-14	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	14-50	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	50-60	Silty clay loam, silty clay, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	95-100	35-80	10-50
54B----- Zook	0-16	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	16-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
65D, 65E, 65G----- Lindley	0-10	Loam-----	CL	A-6	0	95-100	90-100	85-95	50-65	25-35	10-15
	10-38	Clay loam, loam	CL	A-6, A-7	0-5	90-95	90-100	85-95	55-75	30-45	12-20
	38-60	Loam, clay loam	CL	A-6	0-5	90-95	90-100	85-95	50-70	25-35	10-15
69C, 69C2----- Clearfield	0-14	Silty clay loam	CH, CL, ML	A-7	0	100	100	100	95-100	45-55	20-30
	14-48	Silty clay loam	CH	A-7	0	100	100	100	95-100	50-60	25-35
	48-60	Silty clay, silty clay loam, clay.	CH	A-7	0	100	100	95-100	80-90	55-70	35-45
76C----- Ladoga	0-12	Silt loam-----	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	12-32	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	32-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
76C2----- Ladoga	0-6	Silty clay loam	CL	A-6	0	100	100	100	95-100	30-40	10-20
	6-33	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	33-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
76D----- Ladoga	0-12	Silt loam-----	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	12-32	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	32-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
88----- Nevin	0-19	Silty clay loam	CL, OL	A-6, A-7	0	100	100	100	90-95	35-45	10-20
	19-24	Silty clay loam	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
	24-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
93D*, 93D2*: Shelby-----	0-12	Clay loam-----	CL	A-6, A-7	0	90-95	85-95	75-90	55-70	35-45	15-25
	12-43	Clay loam-----	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	43-60	Clay loam-----	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
Adair-----	0-12	Clay loam-----	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	10-20
	12-49	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	49-60	Clay loam-----	CL	A-6, A-7	0-5	90-95	80-95	70-90	55-80	35-50	15-25
94D*: Mystic-----	0-11	Loam-----	CL	A-6, A-7	0	100	100	80-100	65-90	30-45	10-25
	11-60	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	90-100	80-100	65-80	40-55	25-35
Caleb-----	0-12	Loam-----	CL	A-6	0	95-100	85-100	70-90	60-80	30-40	10-20
	12-36	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-100	85-100	60-80	50-75	35-45	15-25
	36-60	Sandy clay loam, sandy loam, clay loam.	SC, CL, SM-SC, CL-ML	A-6, A-4	0	95-100	85-100	70-90	35-80	20-40	5-20
94D2*: Mystic-----	0-6	Clay loam-----	CL	A-6, A-7	0	100	100	80-100	65-90	30-45	10-25
	6-60	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	90-100	80-100	65-80	40-55	25-35
Caleb-----	0-6	Loam-----	CL	A-6	0	95-100	85-100	70-90	60-80	30-40	10-20
	6-49	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-100	85-100	60-80	50-75	35-45	15-25
	49-60	Sandy clay loam, sandy loam, clay loam.	SC, CL, SM-SC, CL-ML	A-6, A-4	0	95-100	85-100	70-90	35-80	20-40	5-20
131B, 131C----- Pershing	0-10	Silt loam-----	CL	A-6	0	100	100	100	95-100	30-40	10-20
	10-15	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	15-33	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
	33-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-55	20-35

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
131C2----- Pershing	0-5	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	5-8	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	8-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
131D----- Pershing	0-10	Silt loam-----	CL	A-6	0	100	100	100	95-100	30-40	10-20
	10-15	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	15-33	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
	33-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-55	20-35
131D2----- Pershing	0-5	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	5-8	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	8-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
132C----- Weller	0-9	Silt loam-----	ML, CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	9-41	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-65	30-40
	41-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	30-55	10-30
172----- Wabash	0-20	Silty clay-----	CH	A-7	0	100	100	100	95-100	50-75	30-50
	20-60	Silty clay, clay	CH	A-7	0	100	100	100	95-100	52-78	30-55
172+----- Wabash	0-11	Silt loam-----	CL	A-6	0	100	100	100	95-100	30-40	10-20
	11-60	Silty clay, clay	CH	A-7	0	100	100	100	95-100	52-78	30-55
175C, 175D----- Dickinson	0-15	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	15-37	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	37-46	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
	46-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP
179D----- Gara	0-13	Loam-----	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
	13-28	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	28-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
179D2----- Gara	0-6	Loam-----	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-28	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	28-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
179D3----- Gara	0-6	Clay loam-----	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-28	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	28-60	Loam, clay loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
179E----- Gara	0-13	Loam-----	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
	13-28	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	28-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
179E2----- Gara	0-6	Loam-----	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-28	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	28-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
179F----- Gara	0-13	Loam-----	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
	13-28	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	28-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
179F2----- Gara	0-6	Loam-----	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-28	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	28-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
192C, 192C2, 192D2----- Adair	0-13	Clay loam-----	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	10-20
	13-34	Silty clay, clay, clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	34-60	Clay loam-----	CL	A-6, A-7	0-5	90-95	80-95	70-90	55-80	35-50	15-25
211----- Edina	0-15	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	15-45	Silty clay-----	CH	A-7	0	100	100	95-100	90-100	55-75	30-45
	45-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-60	15-35
212----- Kennebec	0-40	Silt loam-----	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
	40-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
220----- Nodaway	0-7	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
	7-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-40	5-15
222C, 222C2, 222D, 222D2----- Clarinda	0-11	Silty clay loam	CL	A-7	0	100	95-100	90-100	85-100	40-50	20-30
	11-31	Silty clay, clay	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
	31-60	Clay, silty clay	CH	A-7	0	95-100	95-100	80-95	75-90	55-70	35-45
269----- Humeston	0-11	Silty clay loam	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
	11-25	Silt loam-----	CL, CL-ML	A-6, A-4	0	100	100	95-100	95-100	25-40	5-15
	25-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	45-55	25-35
269+----- Humeston	0-12	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	12-37	Silt loam-----	CL, CL-ML	A-6, A-4	0	100	100	95-100	95-100	25-40	5-15
	37-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	45-55	25-35
269B----- Humeston	0-11	Silty clay loam	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
	11-25	Silt loam-----	CL, CL-ML	A-6, A-4	0	100	100	95-100	95-100	25-40	5-15
	25-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	45-55	25-35
269B+----- Humeston	0-12	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	12-37	Silt loam-----	CL, CL-ML	A-6, A-4	0	100	100	95-100	95-100	25-40	5-15
	37-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	45-55	25-35
273B, 273C----- Olmitz	0-25	Loam-----	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
	25-60	Loam, clay loam	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
287B*: Zook-----	0-16	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	16-50	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	50-60	Silty clay loam, silty clay, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	95-100	35-80	10-50

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
287B*: Ely-----	0-25	Silty clay loam	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	25-47	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
	47-60	Silt loam, silty clay loam, loam.	CL	A-6	0	100	100	90-100	85-100	25-40	10-20
362----- Haig	0-19	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	100	95-100	40-55	15-25
	19-45	Silty clay-----	CH	A-7	0	100	100	100	95-100	50-65	30-40
	45-60	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	20-30
364B----- Grundy	0-16	Silty clay loam	CH, CL	A-7	0	100	100	95-100	90-100	40-55	20-35
	16-20	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	90-100	45-55	25-35
	20-45	Silty clay-----	CH	A-7	0	100	100	95-100	90-100	50-70	30-45
	45-60	Silty clay loam	CH, CL	A-7	0	100	100	90-100	90-100	40-55	25-35
368B----- Macksburg	0-12	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	12-51	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	51-60	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
369----- Winterset	0-17	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	17-38	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-70	30-40
	38-60	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	25-35
370B, 370C, 370C2, 370D----- Sharpsburg	0-17	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	18-32
	17-48	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	48-60	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
423C, 423C2, 423D, 423D2----- Bucknell	0-8	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	8-46	Clay, clay loam	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	46-60	Clay loam-----	CL	A-6, A-7	0-5	90-95	95-100	70-90	55-85	35-50	15-30
425C, 425D----- Keswick	0-9	Silt loam-----	CL, CL-ML	A-6, A-4	0-5	90-100	80-100	75-90	60-80	20-30	5-15
	9-32	Clay loam, clay	CH, CL	A-7	0-5	90-100	80-100	70-90	55-80	40-70	20-40
	32-60	Clay loam-----	CL	A-6	0-5	90-100	80-100	70-90	55-80	30-40	15-25
428B----- Ely	0-25	Silty clay loam	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	25-47	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
	47-60	Silt loam, silty clay loam, loam.	CL	A-6	0	100	100	90-100	85-100	25-40	10-20
430----- Ackmore	0-32	Silt loam-----	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	8-20
	32-60	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	8-20
451D2, 451F2----- Caleb	0-6	Loam-----	CL	A-6	0	95-100	85-100	70-90	60-80	30-40	10-20
	6-49	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-100	85-100	60-80	50-75	35-45	15-25
	49-60	Sandy clay loam, sandy loam, clay loam.	SC, CL, SM-SC, CL-ML	A-6, A-4	0	95-100	85-100	70-90	35-80	20-40	5-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
452C, 452C2----- Lineville	0-11	Silt loam-----	CL, ML	A-6, A-7	0	100	100	95-100	95-100	35-45	10-20
	11-19	Silty clay loam	CL, CH	A-7	0	100	100	95-100	95-100	45-55	25-35
	19-46	Clay loam, loam	CL	A-6, A-7	0	95-100	80-100	75-95	65-90	35-50	20-35
	46-60	Clay loam, clay	CH, CL	A-7	0-5	95-100	80-100	70-90	55-80	45-60	25-35
470D*, 470D2*: Lamoni-----	0-10	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	10-33	Clay loam, clay	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	33-60	Clay loam-----	CL	A-6, A-7	0-5	90-95	95-100	70-90	55-85	35-50	15-30
Shelby-----	0-12	Clay loam-----	CL	A-6, A-7	0	90-95	85-95	75-90	55-70	35-45	15-25
	12-38	Clay loam-----	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	38-60	Clay loam-----	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
534----- Carlow	0-17	Silty clay-----	CL, CH	A-7	0	100	100	95-100	95-100	40-65	25-40
	17-60	Silty clay, clay	CL, CH	A-7	0	100	100	95-100	95-100	45-75	30-50
534+----- Carlow	0-14	Silt loam-----	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
	14-60	Silty clay, clay	CL, CH	A-7	0	100	100	95-100	95-100	45-75	30-50
570C, 570C2, 570D, 570D2----- Nira	0-11	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-25
	11-46	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	20-30
	46-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
592C----- Mystic	0-13	Loam-----	CL	A-6, A-7	0	100	100	80-100	65-90	30-45	10-25
	13-33	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	90-100	80-100	65-80	40-55	25-35
	33-60	Sandy clay loam, loam.	SC, CL, SM-SC, CL-ML	A-6, A-4	0-5	90-100	80-100	70-95	40-65	25-40	5-20
592C2----- Mystic	0-6	Clay loam-----	CL	A-6, A-7	0	100	100	80-100	65-90	30-45	10-25
	6-33	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	90-100	80-100	65-80	40-55	25-35
	33-60	Sandy clay loam, loam.	SC, CL, SM-SC, CL-ML	A-6, A-4	0-5	90-100	80-100	70-95	40-65	25-40	5-20
592D----- Mystic	0-13	Loam-----	CL	A-6, A-7	0	100	100	80-100	65-90	30-45	10-25
	13-33	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	90-100	80-100	65-80	40-55	25-35
	33-60	Sandy clay loam, loam.	SC, CL, SM-SC, CL-ML	A-6, A-4	0-5	90-100	80-100	70-95	40-65	25-40	5-20
592D2, 592E2----- Mystic	0-6	Clay loam-----	CL	A-6, A-7	0	100	100	80-100	65-90	30-45	10-25
	6-33	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	90-100	80-100	65-80	40-55	25-35
	33-60	Sandy clay loam, loam.	SC, CL, SM-SC, CL-ML	A-6, A-4	0-5	90-100	80-100	70-95	40-65	25-40	5-20
792C----- Armstrong	0-12	Loam-----	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	12-45	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	45-60	Clay loam-----	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
792C2----- Armstrong	0-6	Clay loam-----	CL	A-6, A-7	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	6-60	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
792D----- Armstrong	0-12	Loam-----	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	12-45	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	45-60	Clay loam-----	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
792D2----- Armstrong	0-6	Clay loam-----	CL	A-6, A-7	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	6-60	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
822C, 822C2, 822D, 822D2----- Lamoni	0-11	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	11-33	Clay loam, clay	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	33-60	Clay loam-----	CL	A-6, A-7	0-5	90-95	95-100	70-90	55-85	35-50	15-30
831C2----- Pershing	0-5	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	5-28	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	28-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
870B, 870C2----- Sharpsburg	0-17	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	18-32
	17-53	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	53-60	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
993D*: Gara-----	0-13	Loam-----	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
	13-28	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	28-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
Armstrong-----	0-12	Loam-----	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	12-45	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	45-60	Clay loam-----	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
993D2*: Gara-----	0-6	Loam-----	CL	A-6, A-7	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-28	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	28-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
Armstrong-----	0-6	Clay loam-----	CL	A-6, A-7	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	6-45	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	45-60	Clay loam-----	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
1220----- Nodaway	0-7	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
	7-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-40	5-15
5010*, 5030*. Pits											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction pH	Shrink-swell potential	Erosion factors		Wind erodi- bility group
								K	T	
	In	Pct	g/cc	In/hr	In/in	pH				
13B*:										
Olmitz-----	0-28	24-30	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6
	28-60	24-30	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28		
Zook-----	0-16	35-40	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High-----	0.28	5	7
	16-50	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High-----	0.28		
	50-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High-----	0.28		
Humeston-----	0-11	27-30	1.35-1.40	0.2-0.6	0.21-0.23	5.1-7.3	Moderate-----	0.32	4	7
	11-25	20-26	1.30-1.35	0.2-2.0	0.20-0.22	4.5-6.0	Moderate-----	0.32		
	25-60	30-48	1.35-1.50	<0.06	0.13-0.15	4.5-6.5	High-----	0.32		
23C, 23C2-----	0-10	21-38	1.35-1.40	0.6-2.0	0.21-0.23	5.6-7.3	High-----	0.32	3	7
Arispe	10-48	35-42	1.35-1.45	0.06-0.2	0.18-0.20	5.6-7.3	High-----	0.43		
	48-60	30-38	1.35-1.45	0.2-0.6	0.18-0.20	6.1-7.3	High-----	0.43		
24D, 24D2, 24E, 24E2-----	0-12	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28	5	6
Shelby	12-38	30-35	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28		
	38-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
54-----	0-16	35-40	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High-----	0.28	5	7
Zook	16-50	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High-----	0.28		
	50-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High-----	0.28		
54+-----	0-14	20-26	1.30-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	6
Zook	14-50	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High-----	0.28		
	50-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High-----	0.28		
54B-----	0-16	32-38	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High-----	0.28	5	7
Zook	16-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High-----	0.28		
65D, 65E, 65G----	0-10	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low-----	0.32	5	6
Lindley	10-38	25-35	1.40-1.60	0.2-0.6	0.14-0.18	4.5-6.5	Moderate-----	0.32		
	38-60	18-32	1.45-1.65	0.2-0.6	0.12-0.16	6.1-7.8	Moderate-----	0.32		
69C, 69C2-----	0-14	32-38	1.30-1.40	0.2-0.6	0.21-0.23	5.6-7.3	High-----	0.28	5	4
Clearfield	14-48	35-40	1.30-1.45	0.2-0.6	0.18-0.20	5.6-7.3	High-----	0.43		
	48-60	40-50	1.40-1.65	<0.06	0.10-0.12	5.6-7.3	High-----	0.43		
76C-----	0-12	18-27	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low-----	0.32	5	6
Ladoga	12-32	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	32-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
76C2-----	0-6	27-35	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low-----	0.32	5	7
Ladoga	6-33	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	33-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
76D-----	0-12	18-27	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low-----	0.32	5	6
Ladoga	12-32	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	32-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
88-----	0-19	27-29	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
Nevin	19-24	30-35	1.30-1.40	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43		
	24-60	25-36	1.40-1.45	0.6-2.0	0.18-0.20	6.6-7.3	Moderate-----	0.43		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group
								K	T	
	In	Pct	g/cc	In/hr	In/in	pH				
93D*, 93D2*: Shelby-----	0-12	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28	5	6
	12-43	30-35	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28		
	43-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
Adair-----	0-12	35-42	1.45-1.50	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.32	3	4
	12-49	38-55	1.50-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High-----	0.32		
	49-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32		
94D*: Mystic-----	0-11	22-29	1.40-1.45	0.6-2.0	0.22-0.24	4.5-6.5	Moderate-----	0.37	3	6
	11-60	30-48	1.45-1.65	0.06-0.2	0.15-0.19	5.6-6.5	High-----	0.37		
Caleb-----	0-12	22-27	1.45-1.50	0.6-2.0	0.14-0.18	4.5-7.3	Low-----	0.28	5	6
	12-36	20-35	1.45-1.65	0.6-2.0	0.14-0.18	4.5-6.0	Moderate-----	0.28		
	36-60	5-30	1.55-1.75	0.6-2.0	0.12-0.16	5.6-6.5	Low-----	0.28		
94D2*: Mystic-----	0-6	27-32	1.40-1.45	0.6-2.0	0.22-0.24	4.5-6.5	Moderate-----	0.37	3	6
	6-60	30-48	1.45-1.65	0.06-0.2	0.15-0.19	5.6-6.5	High-----	0.37		
Caleb-----	0-6	22-27	1.45-1.50	0.6-2.0	0.14-0.18	4.5-7.3	Low-----	0.28	5	6
	6-49	20-35	1.45-1.65	0.6-2.0	0.14-0.18	4.5-6.0	Moderate-----	0.28		
	49-60	5-30	1.55-1.75	0.6-2.0	0.12-0.16	5.6-6.5	Low-----	0.28		
131B, 131C----- Pershing	0-10	20-27	1.30-1.40	0.6-2.0	0.22-0.24	4.5-7.3	Low-----	0.37	3	6
	10-15	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate-----	0.37		
	15-33	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High-----	0.37		
	33-60	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High-----	0.37		
131C2----- Pershing	0-5	27-38	1.30-1.40	0.2-0.6	0.22-0.24	4.5-7.3	Moderate-----	0.37	3	7
	5-8	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate-----	0.37		
	8-60	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High-----	0.37		
131D----- Pershing	0-10	20-27	1.30-1.40	0.6-2.0	0.22-0.24	4.5-7.3	Low-----	0.37	3	6
	10-15	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate-----	0.37		
	15-33	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High-----	0.37		
	33-60	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High-----	0.37		
131D2----- Pershing	0-5	27-38	1.30-1.40	0.2-0.6	0.22-0.24	4.5-7.3	Moderate-----	0.37	3	7
	5-8	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate-----	0.37		
	8-60	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High-----	0.37		
132C----- Weller	0-9	16-27	1.35-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low-----	0.43	3	6
	9-41	28-48	1.35-1.50	0.06-0.2	0.12-0.18	4.5-6.0	High-----	0.43		
	41-60	25-40	1.40-1.55	0.2-0.6	0.18-0.20	5.1-6.0	High-----	0.43		
172----- Wabash	0-20	40-60	1.25-1.45	<0.06	0.12-0.14	5.6-7.3	Very high----	0.28	5	4
	20-60	40-60	1.20-1.45	<0.06	0.08-0.12	5.6-7.8	Very high----	0.28		
172+----- Wabash	0-11	20-27	1.35-1.50	0.2-0.6	0.21-0.24	5.6-7.3	Moderate-----	0.28	5	6
	11-60	40-60	1.20-1.45	<0.06	0.08-0.12	5.6-7.8	Very high----	0.28		
175C, 175D----- Dickinson	0-15	10-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low-----	0.20	4	3
	15-37	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low-----	0.20		
	37-46	4-10	1.55-1.65	6.0-20	0.08-0.10	5.1-6.5	Low-----	0.20		
	46-60	4-10	1.60-1.70	6.0-20	0.02-0.04	5.6-6.5	Low-----	0.15		
179D----- Gara	0-13	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	5	6
	13-28	25-35	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.28		
	28-60	24-35	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group
								K	T	
	In	Pct	g/cc	In/hr	In/in	pH				
179D2----- Gara	0-6 6-28 28-60	27-32 25-35 24-35	1.50-1.55 1.55-1.75 1.65-1.75	0.2-0.6 0.2-0.6 0.2-0.6	0.16-0.18 0.16-0.18 0.16-0.18	5.6-7.3 4.5-6.5 6.6-8.4	Moderate----- Moderate----- Moderate-----	0.28 0.28 0.37	5	6
179D3----- Gara	0-6 6-28 28-60	27-32 25-35 24-35	1.50-1.55 1.55-1.75 1.65-1.75	0.2-0.6 0.2-0.6 0.2-0.6	0.16-0.18 0.16-0.18 0.16-0.18	5.6-7.3 4.5-6.5 5.6-8.4	Moderate----- Moderate----- Moderate-----	0.28 0.28 0.37	4	6
179E----- Gara	0-13 13-28 28-60	24-27 25-35 24-35	1.50-1.55 1.55-1.75 1.65-1.75	0.6-2.0 0.2-0.6 0.2-0.6	0.20-0.22 0.16-0.18 0.16-0.18	5.6-7.3 4.5-6.5 6.6-8.4	Moderate----- Moderate----- Moderate-----	0.28 0.28 0.37	5	6
179E2----- Gara	0-6 6-28 28-60	27-32 25-35 24-35	1.50-1.55 1.55-1.75 1.65-1.75	0.2-0.6 0.2-0.6 0.2-0.6	0.16-0.18 0.16-0.18 0.16-0.18	5.6-7.3 4.5-6.5 6.6-8.4	Moderate----- Moderate----- Moderate-----	0.28 0.28 0.37	5	6
179F----- Gara	0-13 13-28 28-60	24-27 25-35 24-35	1.50-1.55 1.55-1.75 1.65-1.75	0.6-2.0 0.2-0.6 0.2-0.6	0.20-0.22 0.16-0.18 0.16-0.18	5.6-7.3 4.5-6.5 6.6-8.4	Moderate----- Moderate----- Moderate-----	0.28 0.28 0.37	5	6
179F2----- Gara	0-6 6-28 28-60	27-32 25-35 24-35	1.50-1.55 1.55-1.75 1.65-1.75	0.2-0.6 0.2-0.6 0.2-0.6	0.16-0.18 0.16-0.18 0.16-0.18	5.6-7.3 4.5-6.5 6.6-8.4	Moderate----- Moderate----- Moderate-----	0.28 0.28 0.37	5	6
192C, 192C2, 192D2----- Adair	0-13 13-34 34-60	35-42 38-55 30-38	1.45-1.50 1.50-1.60 1.60-1.70	0.2-0.6 0.06-0.2 0.2-0.6	0.17-0.19 0.13-0.16 0.14-0.16	5.6-7.3 5.1-6.5 5.6-7.8	Moderate----- High----- Moderate-----	0.32 0.32 0.32	3	4
211----- Edina	0-15 15-45 45-60	15-27 45-60 27-40	1.35-1.45 1.30-1.45 1.35-1.50	0.6-2.0 <0.06 0.06-0.2	0.22-0.24 0.11-0.13 0.18-0.20	5.1-7.3 5.6-7.3 6.6-7.3	Moderate----- Very high---- High-----	0.37 0.37 0.37	3	6
212----- Kennebec	0-40 40-60	22-27 24-28	1.25-1.35 1.35-1.40	0.6-2.0 0.6-2.0	0.22-0.24 0.20-0.22	5.6-7.3 6.1-7.3	Moderate----- Moderate-----	0.32 0.43	5	6
220----- Nodaway	0-7 7-60	18-27 18-28	1.25-1.35 1.25-1.35	0.6-2.0 0.6-2.0	0.20-0.23 0.20-0.23	6.1-7.3 6.1-7.3	Low----- Moderate-----	0.37 0.37	5	6
222C, 222C2, 222D, 222D2----- Clarinda	0-11 11-31 31-60	30-38 40-60 40-60	1.45-1.50 1.45-1.60 1.50-1.60	0.2-0.6 <0.06 <0.06	0.17-0.19 0.14-0.16 0.14-0.16	5.1-7.3 5.1-6.5 5.6-8.4	Moderate----- High----- High-----	0.37 0.37 0.37	3	7
269----- Humeston	0-11 11-25 25-60	27-30 20-26 30-48	1.35-1.40 1.30-1.35 1.35-1.50	0.2-0.6 0.2-2.0 <0.06	0.21-0.23 0.20-0.22 0.13-0.15	5.1-7.3 4.5-6.0 4.5-6.5	Moderate----- Moderate----- High-----	0.32 0.32 0.32	4	7
269+----- Humeston	0-12 12-37 37-60	24-27 20-30 30-48	1.35-1.40 1.30-1.35 1.35-1.50	0.6-2.0 0.2-2.0 <0.06	0.21-0.23 0.20-0.22 0.13-0.15	5.1-7.3 4.5-6.0 4.5-6.5	Low----- Moderate----- High-----	0.32 0.32 0.32	4	6
269B----- Humeston	0-11 11-25 25-60	27-30 20-26 30-48	1.35-1.40 1.30-1.35 1.35-1.50	0.2-0.6 0.2-2.0 <0.06	0.21-0.23 0.20-0.22 0.13-0.15	5.1-7.3 4.5-6.0 4.5-6.5	Moderate----- Moderate----- High-----	0.32 0.32 0.32	4	7
269B+----- Humeston	0-12 12-37 37-60	24-27 20-30 30-48	1.35-1.40 1.30-1.35 1.35-1.50	0.6-2.0 0.2-2.0 <0.06	0.21-0.23 0.20-0.22 0.13-0.15	5.1-7.3 4.5-6.0 4.5-6.5	Low----- Moderate----- High-----	0.32 0.32 0.32	4	6

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group
	In	Pct	g/cc	In/hr	In/in	pH		K	T	
273B, 273C----- Olmitz	0-25 25-60	24-30 24-30	1.40-1.45 1.40-1.45	0.6-2.0 0.6-2.0	0.19-0.21 0.19-0.21	5.6-7.3 5.6-7.3	Moderate----- Moderate-----	0.28 0.28	5	6
287B*: Zook-----	0-16 16-50 50-60	35-40 36-45 20-45	1.30-1.35 1.30-1.45 1.30-1.45	0.2-0.6 0.06-0.2 0.06-0.6	0.21-0.23 0.11-0.13 0.11-0.22	5.6-7.3 5.6-7.8 5.6-7.8	High----- High----- High-----	0.28 0.28 0.28	5	7
Ely-----	0-25 25-47 47-60	27-30 28-35 20-30	1.30-1.35 1.30-1.40 1.40-1.45	0.6-2.0 0.6-2.0 0.6-2.0	0.21-0.23 0.18-0.20 0.18-0.20	5.6-7.3 6.1-7.3 6.6-7.8	Moderate----- Moderate----- Moderate-----	0.28 0.43 0.43	5	7
362----- Haig	0-19 19-45 45-60	32-40 40-50 28-40	1.35-1.40 1.30-1.45 1.40-1.50	0.6-2.0 <0.06 0.2-0.6	0.21-0.23 0.12-0.14 0.18-0.20	5.6-7.3 5.6-6.5 6.1-7.3	High----- High----- High-----	0.37 0.37 0.37	3	7
364B----- Grundey	0-16 16-20 20-45 45-60	28-35 32-45 40-50 28-35	1.35-1.45 1.35-1.45 1.30-1.40 1.35-1.40	0.2-0.6 0.2-0.6 0.06-0.2 0.06-0.2	0.18-0.20 0.18-0.20 0.11-0.13 0.18-0.20	5.6-7.3 5.6-6.5 5.1-7.3 5.6-7.3	High----- High----- High----- High-----	0.37 0.37 0.37 0.37	3	7
368B----- Macksburg	0-12 12-51 51-60	27-34 36-42 30-38	1.30-1.35 1.35-1.40 1.40-1.45	0.6-2.0 0.2-0.6 0.6-2.0	0.21-0.23 0.18-0.20 0.18-0.20	5.1-6.5 5.1-6.0 5.1-6.5	Moderate----- High----- Moderate-----	0.32 0.43 0.43	5	7
369----- Winterset	0-17 17-38 38-60	27-35 38-42 27-40	1.30-1.35 1.35-1.40 1.40-1.45	0.2-0.6 0.2-0.6 0.2-0.6	0.21-0.23 0.14-0.18 0.18-0.20	5.6-7.3 5.6-6.5 6.1-7.3	Moderate----- High----- Moderate-----	0.28 0.43 0.43	5	7
370B, 370C, 370C2, 370D----- Sharpsburg	0-17 17-48 48-60	27-36 36-42 30-38	1.30-1.35 1.35-1.40 1.40-1.45	0.6-2.0 0.2-0.6 0.6-2.0	0.21-0.23 0.18-0.20 0.18-0.20	5.1-7.3 5.1-6.0 5.1-6.5	Moderate----- Moderate----- Moderate-----	0.32 0.43 0.43	5	7
423C, 423C2, 423D, 423D2----- Bucknell	0-8 8-46 46-60	27-38 38-50 30-40	1.45-1.50 1.55-1.65 1.60-1.70	0.2-0.6 <0.2 0.06-0.2	0.17-0.21 0.13-0.17 0.14-0.18	5.1-7.3 4.5-6.0 5.6-7.3	Moderate----- High----- High-----	0.32 0.32 0.32	3	7
425C, 425D----- Keswick	0-9 9-32 32-60	22-27 35-60 30-40	1.45-1.50 1.45-1.60 1.60-1.75	0.6-2.0 0.06-0.2 0.2-0.6	0.17-0.22 0.11-0.15 0.12-0.16	4.5-7.3 4.5-6.0 4.5-7.3	Moderate----- High----- Moderate-----	0.37 0.37 0.37	3	6
428B----- Ely	0-25 25-47 47-60	27-30 28-35 20-30	1.30-1.35 1.30-1.40 1.40-1.45	0.6-2.0 0.6-2.0 0.6-2.0	0.21-0.23 0.18-0.20 0.18-0.20	5.6-7.3 6.1-7.3 6.6-7.8	Moderate----- Moderate----- Moderate-----	0.28 0.43 0.43	5	7
430----- Ackmore	0-32 32-60	25-27 25-30	1.25-1.30 1.25-1.30	0.6-2.0 0.6-2.0	0.21-0.23 0.21-0.23	5.6-7.3 5.6-7.3	Moderate----- Moderate-----	0.37 0.37	5	6
451D2, 451F2----- Caleb	0-6 6-49 49-60	22-27 20-35 5-30	1.45-1.50 1.45-1.65 1.55-1.75	0.6-2.0 0.6-2.0 0.6-2.0	0.14-0.18 0.14-0.18 0.12-0.16	4.5-7.3 4.5-6.0 5.6-6.5	Low----- Moderate----- Low-----	0.28 0.28 0.28	5	6
452C, 452C2----- Lineville	0-11 11-19 19-46 46-60	22-27 28-35 20-35 28-45	1.45-1.50 1.50-1.55 1.65-1.75 1.65-1.75	0.6-2.0 0.2-0.6 0.06-0.2 0.06-0.2	0.16-0.20 0.17-0.21 0.17-0.21 0.13-0.21	5.1-7.3 5.1-6.0 5.6-6.0 5.6-7.3	Moderate----- Moderate----- Moderate----- High-----	0.37 0.37 0.37 0.37	5	6

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group
								K	T	
	In	Pct	g/cc	In/hr	In/in	pH				
470D*, 470D2*: Lamoni-----	0-10	27-40	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate-----	0.32	3	6
	10-33	38-50	1.55-1.65	<0.2	0.13-0.17	5.1-6.5	High-----	0.32		
	33-60	32-40	1.60-1.70	0.06-0.2	0.14-0.18	6.6-7.8	High-----	0.32		
Shelby-----	0-12	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28	5	6
	12-38	30-35	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28		
	38-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
534----- Carlow	0-17	40-50	1.30-1.40	0.06-0.2	0.12-0.14	6.1-6.5	High-----	0.37	5	4
	17-60	45-60	1.25-1.35	<0.06	0.09-0.12	5.6-6.5	High-----	0.37		
534+----- Carlow	0-14	18-27	1.35-1.50	0.2-0.6	0.21-0.23	6.1-6.5	Moderate-----	0.37	5	6
	14-60	45-60	1.25-1.35	<0.06	0.09-0.12	5.6-6.5	High-----	0.37		
570C, 570C2, 570D, 570D2----- Nira	0-11	28-34	1.25-1.40	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
	11-46	30-35	1.25-1.40	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	46-60	24-34	1.35-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43		
592C----- Mystic	0-13	22-29	1.40-1.45	0.6-2.0	0.22-0.24	4.5-6.5	Moderate-----	0.37	3	6
	13-33	35-48	1.45-1.65	0.06-0.2	0.15-0.19	4.5-6.5	High-----	0.37		
	33-60	20-35	1.65-1.75	0.6-2.0	0.16-0.18	5.6-6.5	Moderate-----	0.37		
592C2----- Mystic	0-6	27-32	1.40-1.45	0.6-2.0	0.22-0.24	4.5-6.5	Moderate-----	0.37	3	6
	6-33	35-48	1.45-1.65	0.06-0.2	0.15-0.19	4.5-6.5	High-----	0.37		
	33-60	20-35	1.65-1.75	0.6-2.0	0.16-0.18	5.6-6.5	Moderate-----	0.37		
592D----- Mystic	0-13	22-29	1.40-1.45	0.6-2.0	0.22-0.24	4.5-6.5	Moderate-----	0.37	3	6
	13-33	35-48	1.45-1.65	0.06-0.2	0.15-0.19	4.5-6.5	High-----	0.37		
	33-60	20-35	1.65-1.75	0.6-2.0	0.16-0.18	5.6-6.5	Moderate-----	0.37		
592D2, 592E2----- Mystic	0-6	27-32	1.40-1.45	0.6-2.0	0.22-0.24	4.5-6.5	Moderate-----	0.37	3	6
	6-33	35-48	1.45-1.65	0.06-0.2	0.15-0.19	4.5-6.5	High-----	0.37		
	33-60	20-35	1.65-1.75	0.6-2.0	0.16-0.18	5.6-6.5	Moderate-----	0.37		
792C----- Armstrong	0-12	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6
	12-45	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High-----	0.32		
	45-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.3	Moderate-----	0.32		
792C2----- Armstrong	0-6	35-42	1.45-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.32	3	4
	6-60	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High-----	0.32		
792D----- Armstrong	0-12	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6
	12-45	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High-----	0.32		
	45-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.3	Moderate-----	0.32		
792D2----- Armstrong	0-6	35-42	1.45-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.32	3	4
	6-60	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High-----	0.32		
822C, 822C2, 822D, 822D2----- Lamoni	0-11	27-40	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate-----	0.32	3	6
	11-33	38-50	1.55-1.65	<0.2	0.13-0.17	5.1-6.5	High-----	0.32		
	33-60	32-40	1.60-1.70	0.06-0.2	0.14-0.18	5.6-7.3	High-----	0.32		
831C2----- Pershing	0-5	27-38	1.30-1.40	0.2-0.6	0.22-0.24	4.5-7.3	Moderate-----	0.37	3	7
	5-28	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate-----	0.37		
	28-60	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High-----	0.37		

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group
								K	T	
	In	Pct	g/cc	In/hr	In/in	pH				
870B, 870C2----- Sharpsburg	0-17	27-36	1.30-1.35	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	7
	17-53	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43		
	53-60	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43		
993D*:										
Gara-----	0-13	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	5	6
	13-28	25-35	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.28		
	28-60	24-35	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
Armstrong-----	0-12	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6
	12-45	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High-----	0.32		
	45-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.3	Moderate-----	0.32		
993D2*:										
Gara-----	0-6	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.28	5	6
	6-28	25-35	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.28		
	28-60	24-35	1.65-1.75	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37		
Armstrong-----	0-6	35-42	1.45-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.32	3	4
	6-45	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High-----	0.32		
	45-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.3	Moderate-----	0.32		
1220----- Nodaway	0-7	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low-----	0.37	5	6
	7-60	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.37		
5010*, 5030*. Pits										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
13B*: Olmitz-----	B	None-----	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Zook-----	C/D	Occasional	Brief to long.	Feb-Nov	0-3.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
Humeston-----	C/D	Rare-----	---	---	0-1.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
23C, 23C2----- Arispe	C	None-----	---	---	2.0-4.0	Perched	Nov-Jul	High-----	High-----	Moderate.
24D, 24D2, 24E, 24E2----- Shelby	B	None-----	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
54, 54+----- Zook	C/D	Occasional	Brief to long.	Feb-Nov	0-3.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
54B----- Zook	C/D	None-----	---	---	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
65D, 65E, 65G----- Lindley	C	None-----	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
69C, 69C2----- Clearfield	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Low.
76C, 76C2, 76D----- Ladoga	B	None-----	---	---	4.0-6.0	Apparent	Nov-Jul	Moderate	Moderate	Moderate.
88----- Nevin	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Low.
93D*, 93D2*: Shelby-----	B	None-----	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Adair-----	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
94D*, 94D2*: Mystic-----	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	High-----	Moderate	Moderate.
Caleb-----	B	None-----	---	---	3.0-5.0	Perched	Nov-Jul	Moderate	Moderate	Moderate.
131B, 131C, 131C2, 131D, 131D2----- Pershing	C	None-----	---	---	2.0-4.0	Perched	Nov-Jul	High-----	High-----	Moderate.
132C----- Weller	C	None-----	---	---	2.0-4.0	Perched	Nov-Jul	High-----	High-----	High.
172, 172+----- Wabash	D	Occasional	Brief to long.	Feb-Nov	0-1.0	Apparent	Nov-Jul	Moderate	High-----	Moderate.
175C, 175D----- Dickinson	B	None-----	---	---	>6.0	---	---	Moderate	Low-----	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					<u>Ft</u>					
179D, 179D2, 179D3, 179E, 179E2, 179F, 179F2----- Gara	C	None-----	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
192C, 192C2, 192D2----- Adair	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
211----- Edina	D	None-----	---	---	0.5-2.0	Perched	Nov-Jul	Moderate	High-----	Moderate.
212----- Kennebec	B	Occasional	Brief-----	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	High-----	Moderate	Low.
220----- Nodaway	B	Occasional	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	High-----	Moderate	Low.
222C, 222C2, 222D, 222D2----- Clarinda	D	None-----	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
269, 269+----- Humeston	C/D	Occasional	Very brief	Feb-Nov	0-1.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
269B, 269B+----- Humeston	C/D	Rare-----	---	---	0-1.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
273B, 273C----- Olmitz	B	None-----	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
287B*: Zook-----	C/D	Occasional	Brief to long.	Feb-Nov	0-3.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
Ely-----	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
362----- Haig	C/D	None-----	---	---	1.0-2.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
364B----- Grundy	C	None-----	---	---	1.5-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
368B----- Macksburg	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
369----- Winterset	C	None-----	---	---	1.0-2.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
370B, 370C, 370C2, 370D----- Sharpsburg	B	None-----	---	---	4.0-6.0	Apparent	Nov-Jul	High-----	Moderate	Moderate.
423C, 423C2, 423D, 423D2----- Bucknell	D	None-----	---	---	1.0-3.0	Perched	Nov-Jul	Moderate	High-----	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth Ft	Kind	Months		Uncoated steel	Concrete
425C, 425D----- Keswick	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
428B----- Ely	B	None-----	---	---	2.0-4.0	Apparent	Nov-Jul	High-----	High-----	Moderate.
430----- Ackmore	B	Occasional	Very brief to brief.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	High-----	High-----	Low.
451D2, 451F2----- Caleb	B	None-----	---	---	3.0-5.0	Perched	Nov-Jul	Moderate	Moderate	Moderate.
452C, 452C2----- Lineville	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
470D*, 470D2*: Lamoni-----	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	Moderate	High-----	Moderate.
Shelby-----	B	None-----	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
534, 534+----- Carlow	D	Occasional	Brief to long.	Feb-Nov	0-1.0	Apparent	Nov-Jul	Moderate	High-----	Moderate.
570C, 570C2, 570D, 570D2----- Nira	B	None-----	---	---	4.0-6.0	Apparent	Nov-Jul	High-----	Moderate	Moderate.
592C, 592C2, 592D, 592D2, 592E2----- Mystic	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	High-----	Moderate	Moderate.
792C, 792C2, 792D, 792D2----- Armstrong	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
822C, 822C2, 822D, 822D2----- Lamoni	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	Moderate	High-----	Moderate.
831C2----- Pershing	C	None-----	---	---	2.0-4.0	Perched	Nov-Jul	High-----	High-----	Moderate.
870B, 870C2----- Sharpsburg	B	None-----	---	---	4.0-6.0	Apparent	Nov-Jul	High-----	Moderate	Moderate.
993D*, 993D2*: Gara-----	C	None-----	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Armstrong-----	C	None-----	---	---	1.0-3.0	Perched	Nov-Jul	High-----	High-----	Moderate.
1220----- Nodaway	B	Frequent-----	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	High-----	Moderate	Low.
5010*, 5030*. Pits										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

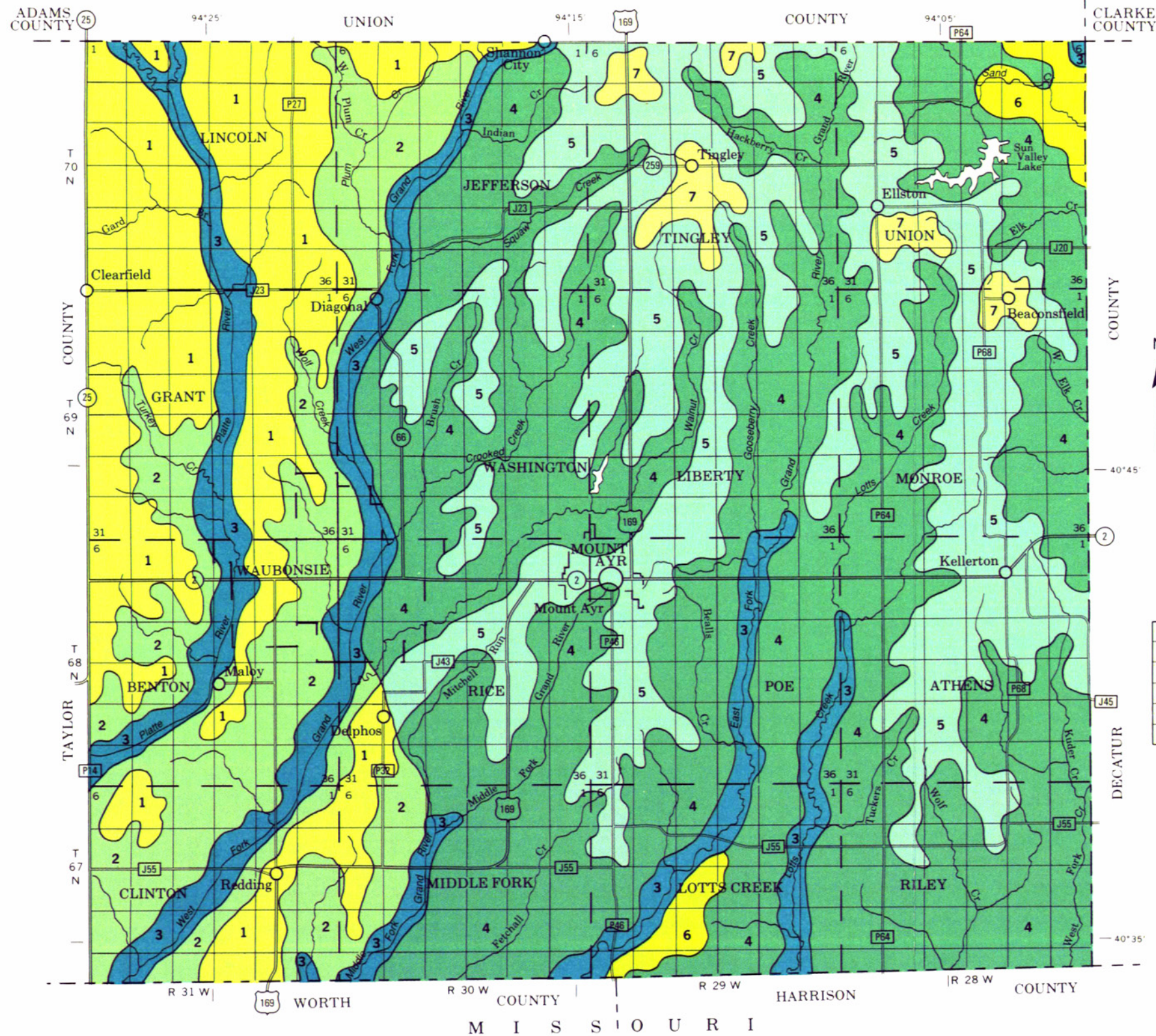
TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Ackmore-----	Fine-silty, mixed, nonacid, mesic Aeric Fluvaquents
Adair-----	Fine, montmorillonitic, mesic Aquic Argiudolls
Arispe-----	Fine, montmorillonitic, mesic Aquic Argiudolls
Armstrong-----	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Bucknell-----	Fine, montmorillonitic, mesic, sloping Udollic Ochraqualfs
Caleb-----	Fine-loamy, mixed, mesic Mollic Hapludalfs
Carlow-----	Fine, montmorillonitic, mesic Vertic Haplaquolls
Clarinda-----	Fine, montmorillonitic, mesic, sloping Typic Argiaquolls
Clearfield-----	Fine, montmorillonitic, mesic, sloping Typic Haplaquolls
Dickinson-----	Coarse-loamy, mixed, mesic Typic Hapludolls
Edina-----	Fine, montmorillonitic, mesic Typic Argialbolls
Ely-----	Fine-silty, mixed, mesic Cumulic Hapludolls
Gara-----	Fine-loamy, mixed, mesic Mollic Hapludalfs
Grundy-----	Fine, montmorillonitic, mesic Aquic Argiudolls
Haig-----	Fine, montmorillonitic, mesic Typic Argiaquolls
Humeston-----	Fine, montmorillonitic, mesic Argiaquic Argialbolls
Kennebec-----	Fine-silty, mixed, mesic Cumulic Hapludolls
Keswick-----	Fine, montmorillonitic, mesic Aquic Hapludalfs
Ladoga-----	Fine, montmorillonitic, mesic Mollic Hapludalfs
Lamoni-----	Fine, montmorillonitic, mesic Aquic Argiudolls
Lindley-----	Fine-loamy, mixed, mesic Typic Hapludalfs
Lineville-----	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Macksburg-----	Fine, montmorillonitic, mesic Aquic Argiudolls
Mystic-----	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Nevin-----	Fine-silty, mixed, mesic Aquic Argiudolls
Nira-----	Fine-silty, mixed, mesic Typic Hapludolls
Nodaway-----	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Olmitz-----	Fine-loamy, mixed, mesic Cumulic Hapludolls
Orthents-----	Loamy, mixed, mesic Udorthents
Pershing-----	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Sharpsburg-----	Fine, montmorillonitic, mesic Typic Argiudolls
Shelby-----	Fine-loamy, mixed, mesic Typic Argiudolls
Wabash-----	Fine, montmorillonitic, mesic Vertic Haplaquolls
Weller-----	Fine, montmorillonitic, mesic Aquic Hapludalfs
Winterset-----	Fine, montmorillonitic, mesic Typic Argiaquolls
Zook-----	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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SOIL LEGEND *

- 1 NIRA-SHARPSBURG-SHELBY ASSOCIATION: Gently sloping to moderately steep, moderately well drained and well drained, silty and loamy soils formed in loess and glacial till; on uplands and stream benches
- 2 GARA-ARMSTRONG-LADOGA ASSOCIATION: Moderately sloping to steep, well drained and moderately well drained, silty and loamy soils formed in glacial till, a paleosol derived from glacial till, and loess; on uplands
- 3 NODAWAY-HUMESTON-WABASH ASSOCIATION: Nearly level and gently sloping, moderately well drained, poorly drained and very poorly drained, silty and clayey soils formed in alluvium; on bottom land along streams
- 4 GARA-ARMSTRONG-PERSHING ASSOCIATION: Gently sloping to steep, well drained to somewhat poorly drained, loamy and silty soils formed in glacial till, a paleosol derived from glacial till, and loess; on uplands and stream benches
- 5 ARISPE-SHELBY-LAMONI ASSOCIATION: Moderately sloping to moderately steep, somewhat poorly drained and well drained, silty and loamy soils formed in loess, glacial till, and a paleosol derived from glacial till; on uplands
- 6 LINDLEY-KESWICK ASSOCIATION: Moderately sloping to very steep, well drained and moderately well drained, loamy soils formed in glacial till and a paleosol derived from glacial till; on uplands
- 7 GRUNDY-HAIG ASSOCIATION: Nearly level and gently sloping, somewhat poorly drained and poorly drained, silty soils formed in loess; on uplands

* Texture terms in the descriptive headings refer to the surface layer of the major soils in the associations.

Compiled 1986

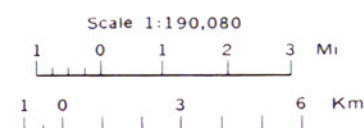
SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

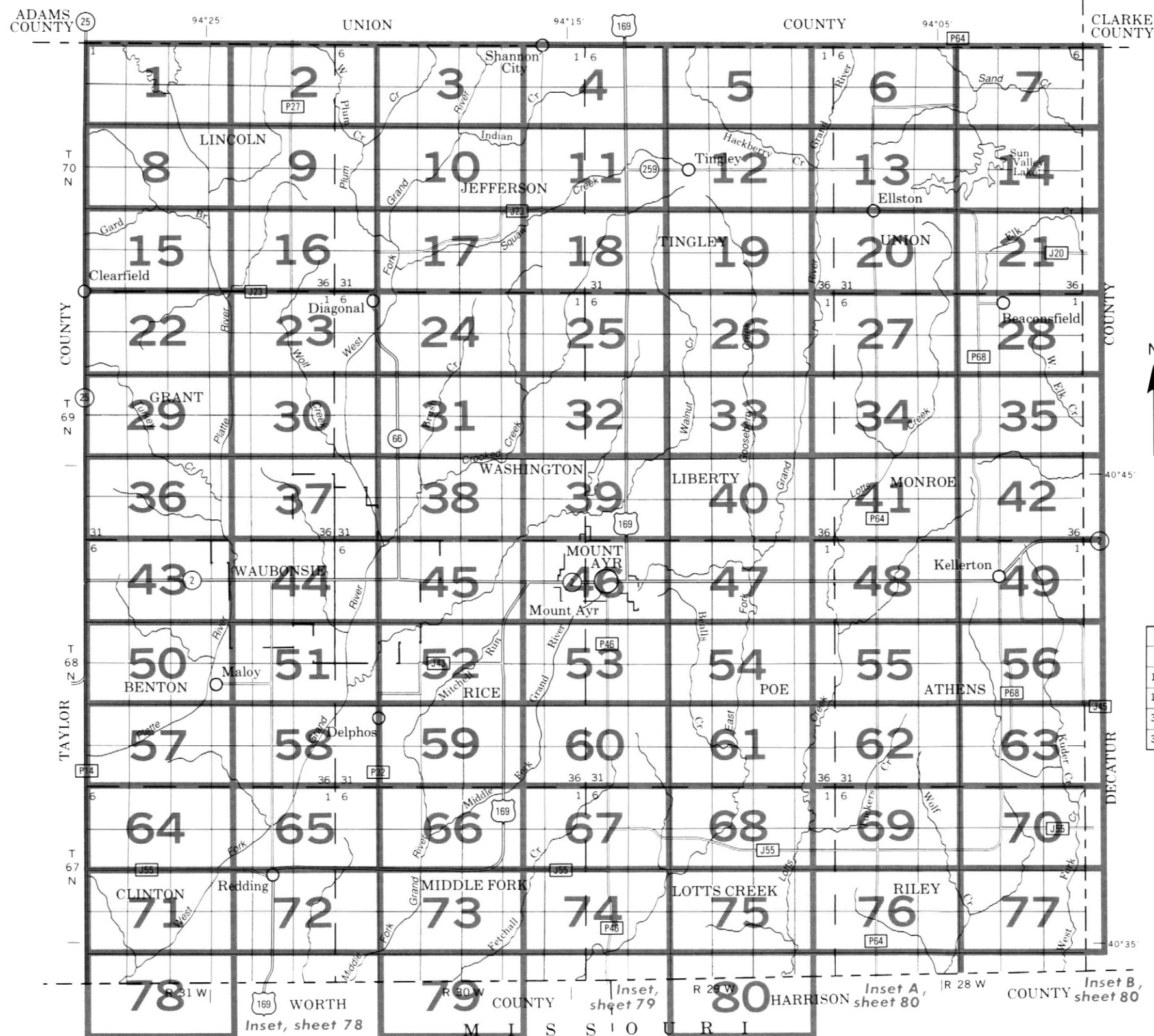
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
IOWA AGRICULTURE AND HOME ECONOMICS EXPERIMENT STATION
COOPERATIVE EXTENSION SERVICE, IOWA STATE UNIVERSITY
DIVISION OF SOIL CONSERVATION, IOWA DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP

GENERAL SOIL MAP

RINGGOLD COUNTY, IOWA



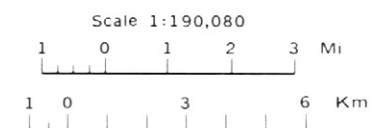
Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



SECTIONALIZED
TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS RINGGOLD COUNTY, IOWA



SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is moderately eroded, and a final number of 3 indicates that the soil is severely eroded.

SYMBOL	NAME	SYMBOL	NAME
13B	Olmitz-Zook-Humeston complex, 0 to 5 percent slopes	273B	Olmitz loam, 2 to 5 percent slopes
23C	Anispe silty clay loam, 5 to 9 percent slopes	273C	Olmitz loam, 5 to 9 percent slopes
23C2	Anispe silty clay loam, 5 to 9 percent slopes, moderately eroded	287B	Zook-Ely silty clay loams, 0 to 5 percent slopes
24D	Shelby clay loam, 9 to 14 percent slopes	362	Haig silty clay loam, 0 to 2 percent slopes
24D2	Shelby clay loam, 9 to 14 percent slopes, moderately eroded	364B	Grundy silty clay loam, 2 to 5 percent slopes
24E	Shelby clay loam, 14 to 18 percent slopes	368B	Macksburg silty clay loam, 1 to 5 percent slopes
24E2	Shelby clay loam, 14 to 18 percent slopes, moderately eroded	369	Winterset silty clay loam, 0 to 2 percent slopes
54	Zook silty clay loam, 0 to 2 percent slopes	370B	Sharpsburg silty clay loam, 2 to 5 percent slopes
54+	Zook silt loam, 0 to 2 percent slopes	370C	Sharpsburg silty clay loam, 5 to 9 percent slopes
54B	Zook silty clay loam, 2 to 5 percent slopes	370C2	Sharpsburg silty clay loam, 5 to 9 percent slopes, moderately eroded
65D	Lindley loam, 9 to 14 percent slopes	370D	Sharpsburg silty clay loam, 9 to 14 percent slopes
65E	Lindley loam, 14 to 18 percent slopes	423C	Bucknell silty clay loam, 5 to 9 percent slopes
65G	Lindley loam, 18 to 40 percent slopes	423C2	Bucknell silty clay loam, 5 to 9 percent slopes, moderately eroded
69C	Clearfield silty clay loam, 5 to 9 percent slopes	423D	Bucknell silty clay loam, 9 to 14 percent slopes
69C2	Clearfield silty clay loam, 5 to 9 percent slopes, moderately eroded	423D2	Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded
76C	Ladoga silt loam, 5 to 9 percent slopes	425C	Keswick silt loam, 5 to 9 percent slopes
76C2	Ladoga silty clay loam, 5 to 9 percent slopes, moderately eroded	425D	Keswick silt loam, 9 to 14 percent slopes
76D	Ladoga silt loam, 9 to 14 percent slopes	428B	Ely silty clay loam, 2 to 5 percent slopes
88	Nevin silty clay loam, 0 to 2 percent slopes	430	Ackmore silt loam, 0 to 2 percent slopes
93D	Shelby-Adair clay loams, 9 to 14 percent slopes	451D2	Caleb loam, 9 to 14 percent slopes, moderately eroded
93D2	Shelby-Adair clay loams, 9 to 14 percent slopes, moderately eroded	451F2	Caleb loam, 14 to 25 percent slopes, moderately eroded
94D	Mystic-Caleb loams, 9 to 14 percent slopes	452C	Lineville silt loam, 5 to 9 percent slopes
94D2	Mystic-Caleb complex, 9 to 14 percent slopes, moderately eroded	452C2	Lineville silt loam, 5 to 9 percent slopes, moderately eroded
131B	Pershing silt loam, 2 to 5 percent slopes	470D	Lamoni-Shelby complex, 9 to 14 percent slopes
131C	Pershing silt loam, 5 to 9 percent slopes	470D2	Lamoni-Shelby complex, 9 to 14 percent slopes, moderately eroded
131C2	Pershing silty clay loam, 5 to 9 percent slopes, moderately eroded	534	Carlow silty clay, 0 to 2 percent slopes
131D	Pershing silt loam, 9 to 14 percent slopes	534+	Carlow silt loam, overwash, 0 to 2 percent slopes
131D2	Pershing silty clay loam, 9 to 14 percent slopes, moderately eroded	570C	Nira silty clay loam, 5 to 9 percent slopes
132C	Weller silt loam, 5 to 9 percent slopes	570C2	Nira silty clay loam, 5 to 9 percent slopes, moderately eroded
172	Wabash silty clay, 0 to 2 percent slopes	570D	Nira silty clay loam, 9 to 14 percent slopes
172+	Wabash silt loam, overwash, 0 to 2 percent slopes	570D2	Nira silty clay loam, 9 to 14 percent slopes, moderately eroded
175C	Dickinson fine sandy loam, 5 to 9 percent slopes	592C	Mystic loam, 5 to 9 percent slopes
175D	Dickinson fine sandy loam, 9 to 14 percent slopes	592C2	Mystic clay loam, 5 to 9 percent slopes, moderately eroded
179D	Gara loam, 9 to 14 percent slopes	592D	Mystic loam, 9 to 14 percent slopes
179D2	Gara loam, 9 to 14 percent slopes, moderately eroded	592D2	Mystic clay loam, 9 to 14 percent slopes, moderately eroded
179D3	Gara clay loam, 9 to 14 percent slopes, severely eroded	592E2	Mystic clay loam, 14 to 18 percent slopes, moderately eroded
179E	Gara loam, 14 to 18 percent slopes	792C	Armstrong loam, 5 to 9 percent slopes
179E2	Gara loam, 14 to 18 percent slopes, moderately eroded	792C2	Armstrong clay loam, 5 to 9 percent slopes, moderately eroded
179F	Gara loam, 18 to 25 percent slopes	792D	Armstrong loam, 9 to 14 percent slopes
179F2	Gara loam, 18 to 25 percent slopes, moderately eroded	792D2	Armstrong clay loam, 9 to 14 percent slopes, moderately eroded
192C	Adair clay loam, 5 to 9 percent slopes	822C	Lamoni silty clay loam, 5 to 9 percent slopes
192C2	Adair clay loam, 5 to 9 percent slopes, moderately eroded	822C2	Lamoni silty clay loam, 5 to 9 percent slopes, moderately eroded
192D2	Adair clay loam, 9 to 14 percent slopes, moderately eroded	822D	Lamoni silty clay loam, 9 to 14 percent slopes
211	Edina silt loam, 0 to 1 percent slopes	822D2	Lamoni silty clay loam, 9 to 14 percent slopes, moderately eroded
212	Kennebec silt loam, 0 to 2 percent slopes	831C2	Pershing silty clay loam, benches, 5 to 9 percent slopes, moderately eroded
220	Nodaway silt loam, 0 to 2 percent slopes	870B	Sharpsburg silty clay loam, benches, 2 to 5 percent slopes
222C	Clarinda silty clay loam, 5 to 9 percent slopes	870C2	Sharpsburg silty clay loam, benches, 5 to 9 percent slopes, moderately eroded
222C2	Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded	993D	Gara-Armstrong loams, 9 to 14 percent slopes
222D	Clarinda silty clay loam, 9 to 14 percent slopes	993D2	Gara-Armstrong complex, 9 to 14 percent slopes, moderately eroded
222D2	Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded	1220	Nodaway silt loam, channeled, 0 to 2 percent slopes
269	Humeston silty clay loam, 0 to 2 percent slopes	5010	Pits, sand and gravel
269+	Humeston silt loam, overwash, 0 to 2 percent slopes	5030	Pits, limestone quarries
269B	Humeston silty clay loam, 2 to 5 percent slopes	5040	Orthents, loamy
269B+	Humeston silt loam, overwash, 2 to 5 percent slopes		

CONVENTIONAL AND SPECIAL
SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

National, state or province

County or parish

Reservation (national forest or park,
state forest or park,
and large airport)

Field sheet matchline & neatline

AD HOC BOUNDARY (label)

Small airport, airfield, park,
cemetery

STATE COORDINATE TICK

LAND DIVISION CORNERS
(sections and land grants)

ROADS

ROAD EMBLEMS & DESIGNATIONS

Federal

State

DAMS

Large (to scale)

Medium or small

PITS

Gravel pit

MISCELLANEOUS CULTURAL FEATURES

Farmstead, house
(omit in urban areas)

Church

School

WATER FEATURES

DRAINAGE

Perennial, double line

Perennial, single line

Intermittent

Crossable with tillage implements

Not crossable with tillage implements

Drainage end

Canals or ditches

Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

Perennial

Intermittent

MISCELLANEOUS WATER FEATURES

Marsh or swamp

Wet spot

Sewage lagoon

SPECIAL SYMBOLS FOR
SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

Other than bedrock
(points down slope)

SHORT STEEP SLOPE

GULLY

SOIL SAMPLE SITE
(normally not shown)

MISCELLANEOUS
(each symbol represents 2 acres or less)

Gravelly spot

Sandy spot

Severely eroded spot

Gray clay spot (paleosol)

Red clay spot (paleosol)

Calcareous spot

Glacial till spot

Area of depressional
gray subsurface soil

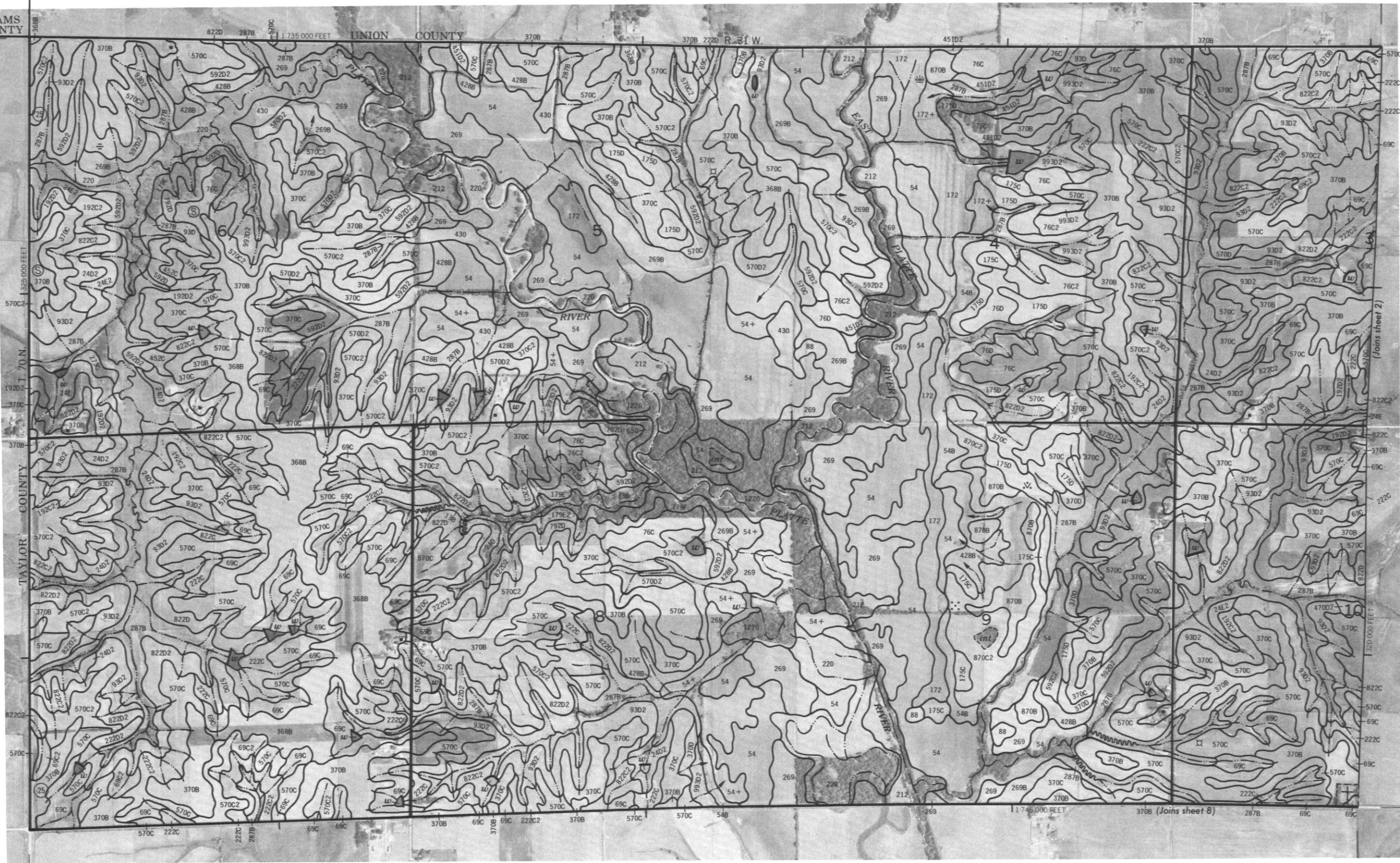
RINGGOLD COUNTY, IOWA NO. 1

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

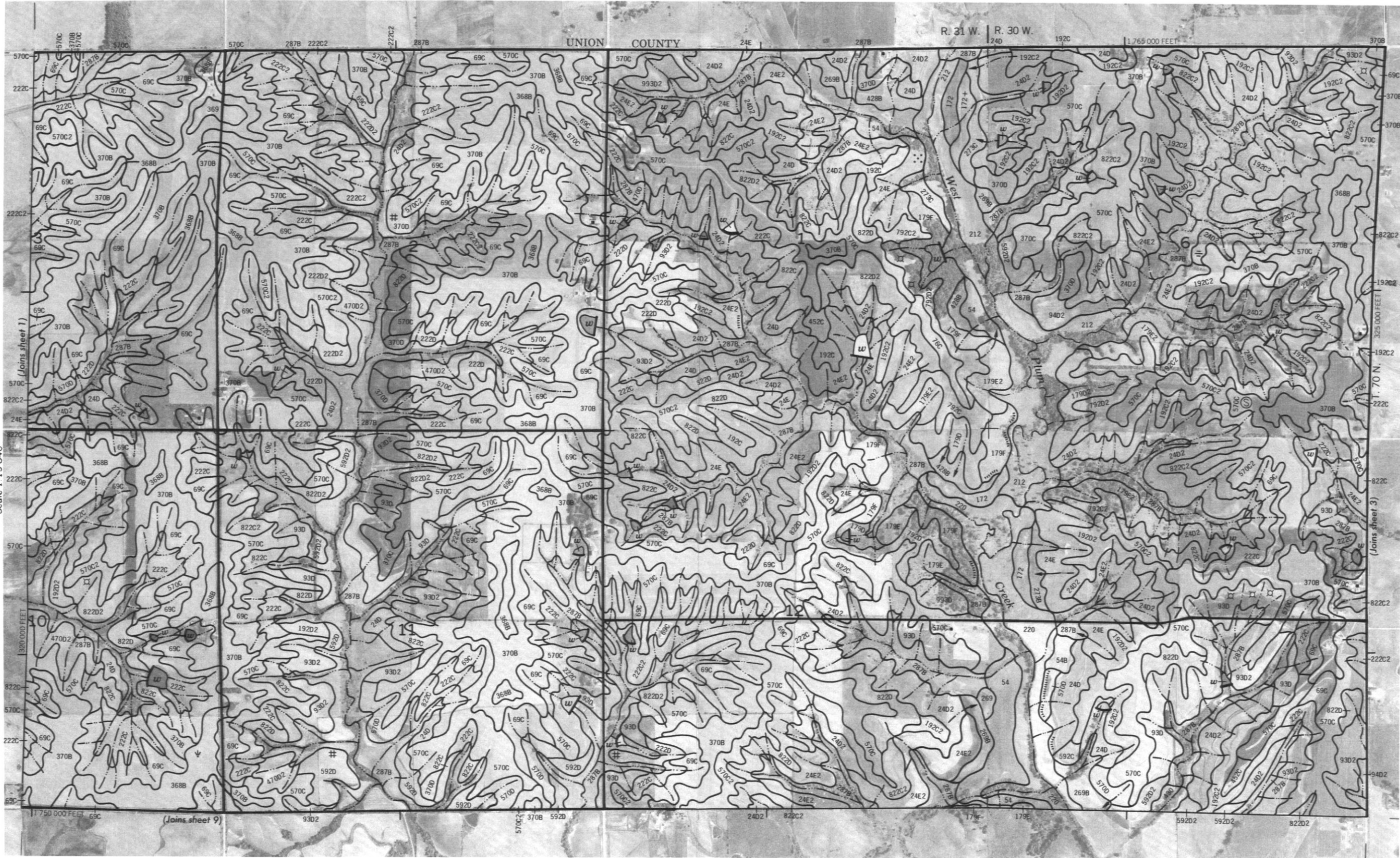
ADAMS COUNTY

UNION COUNTY

370B 2220 R. 31 W.



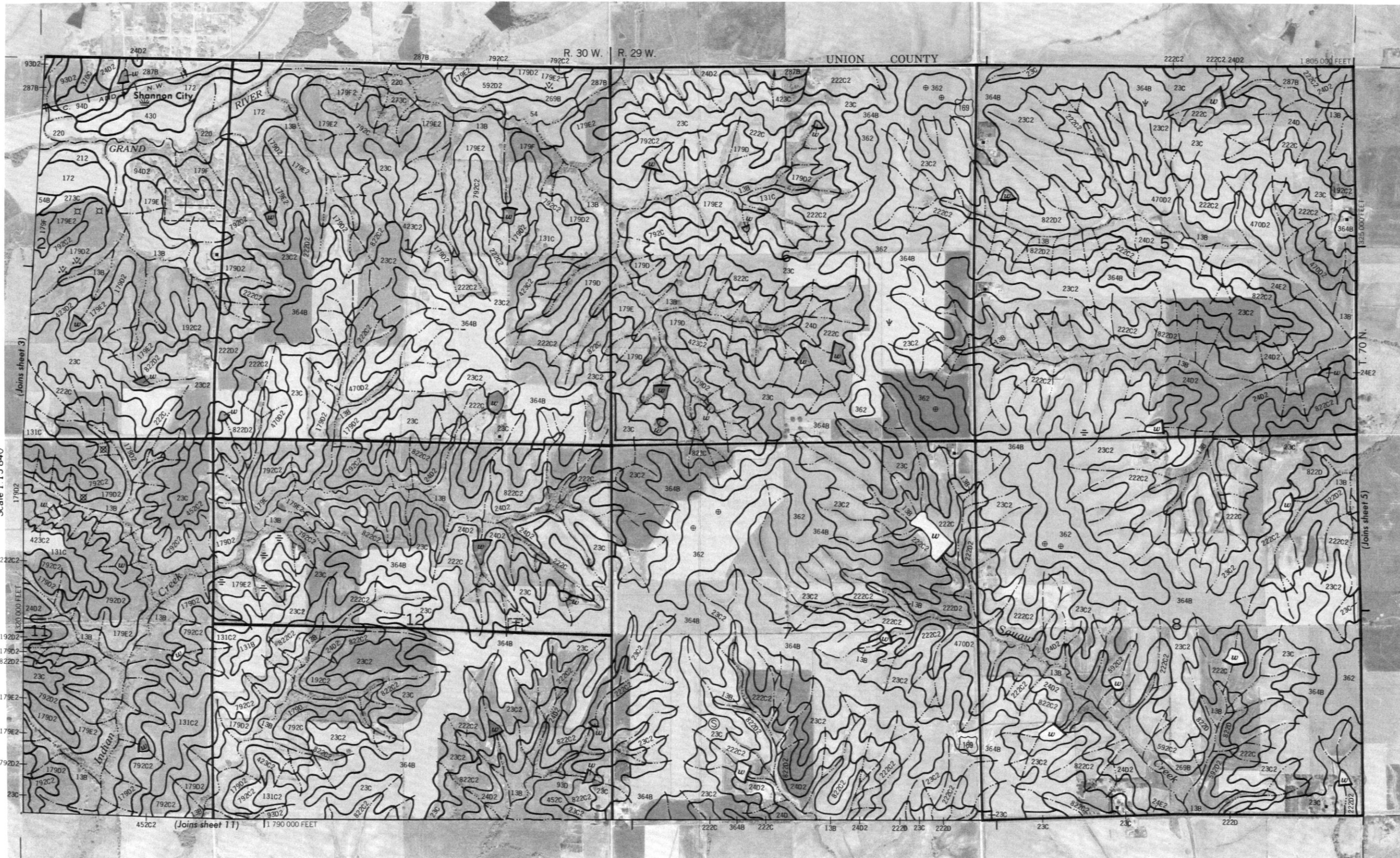
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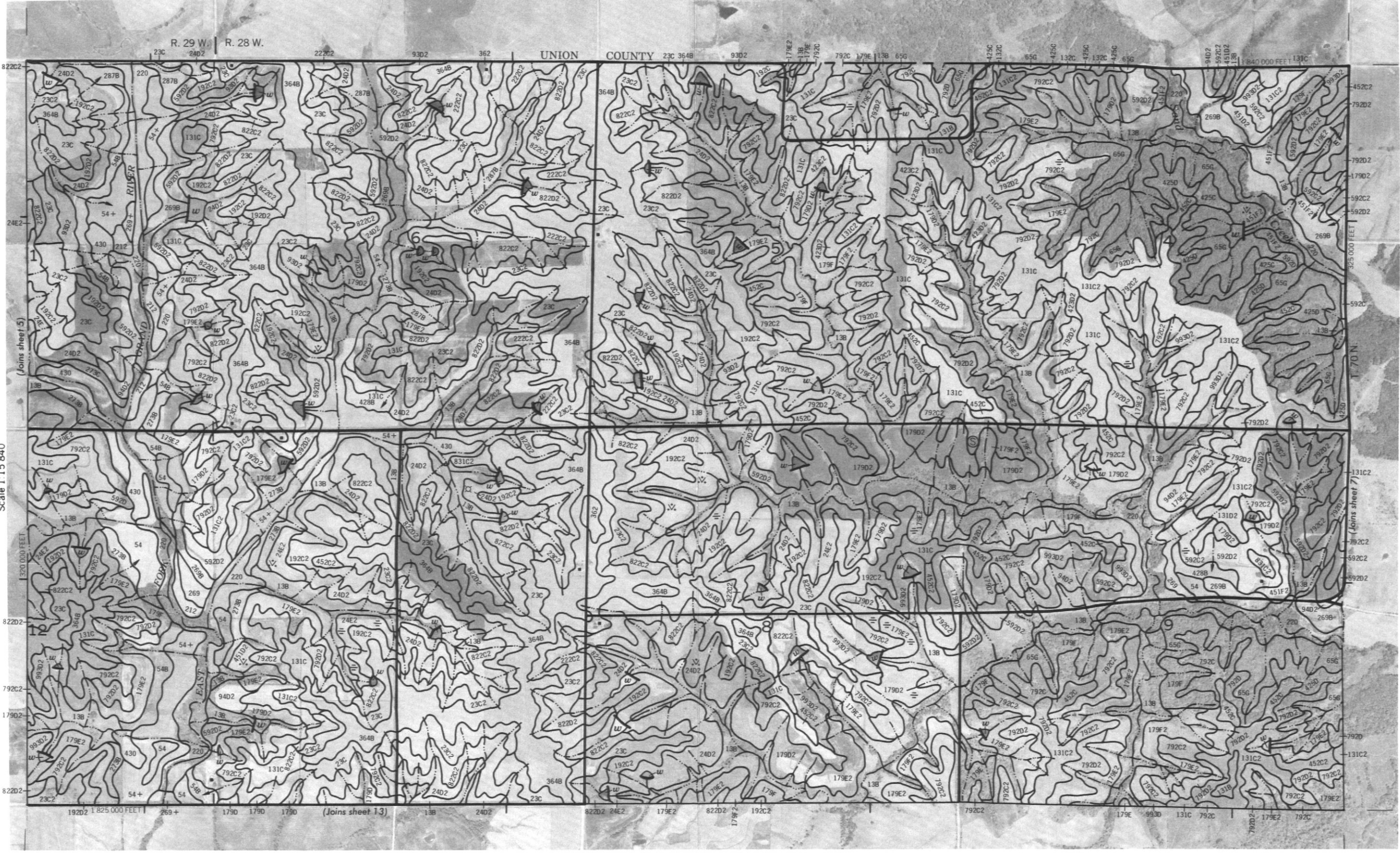
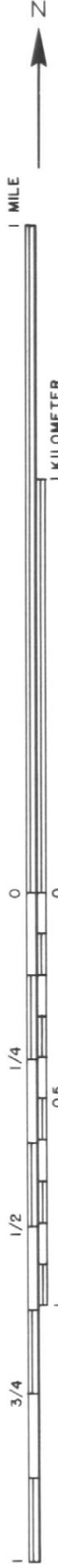
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Scale 1:15 840



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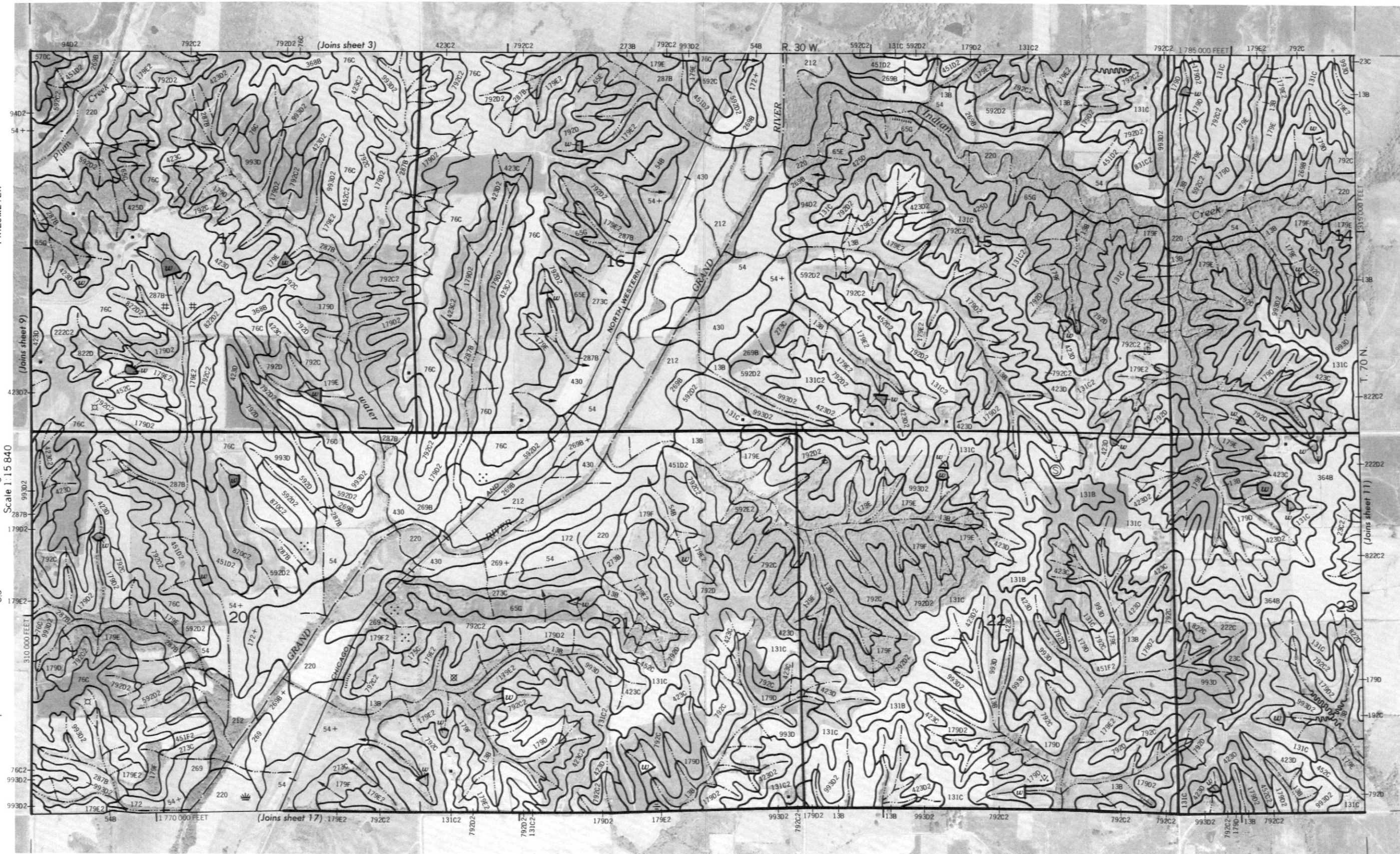
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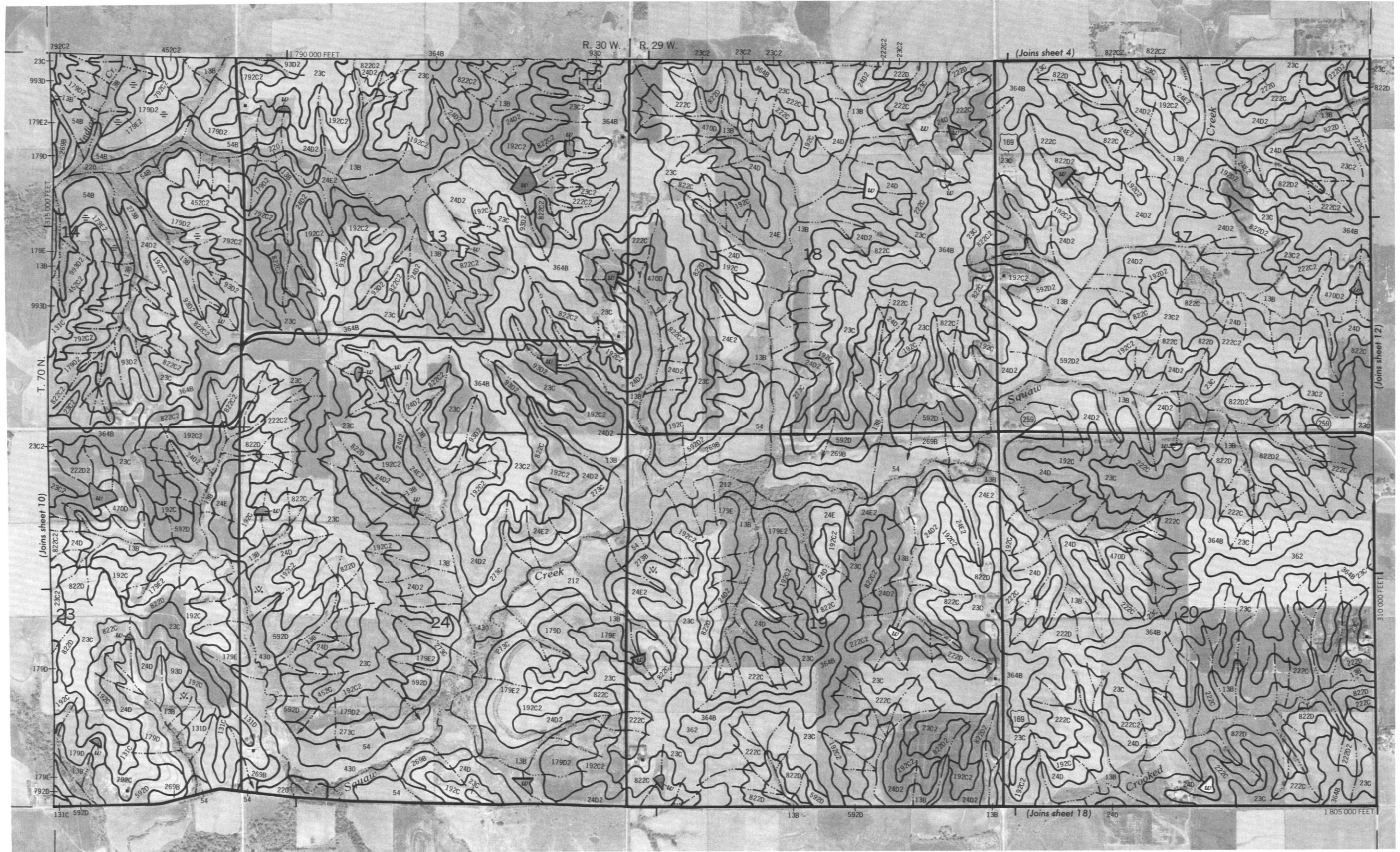
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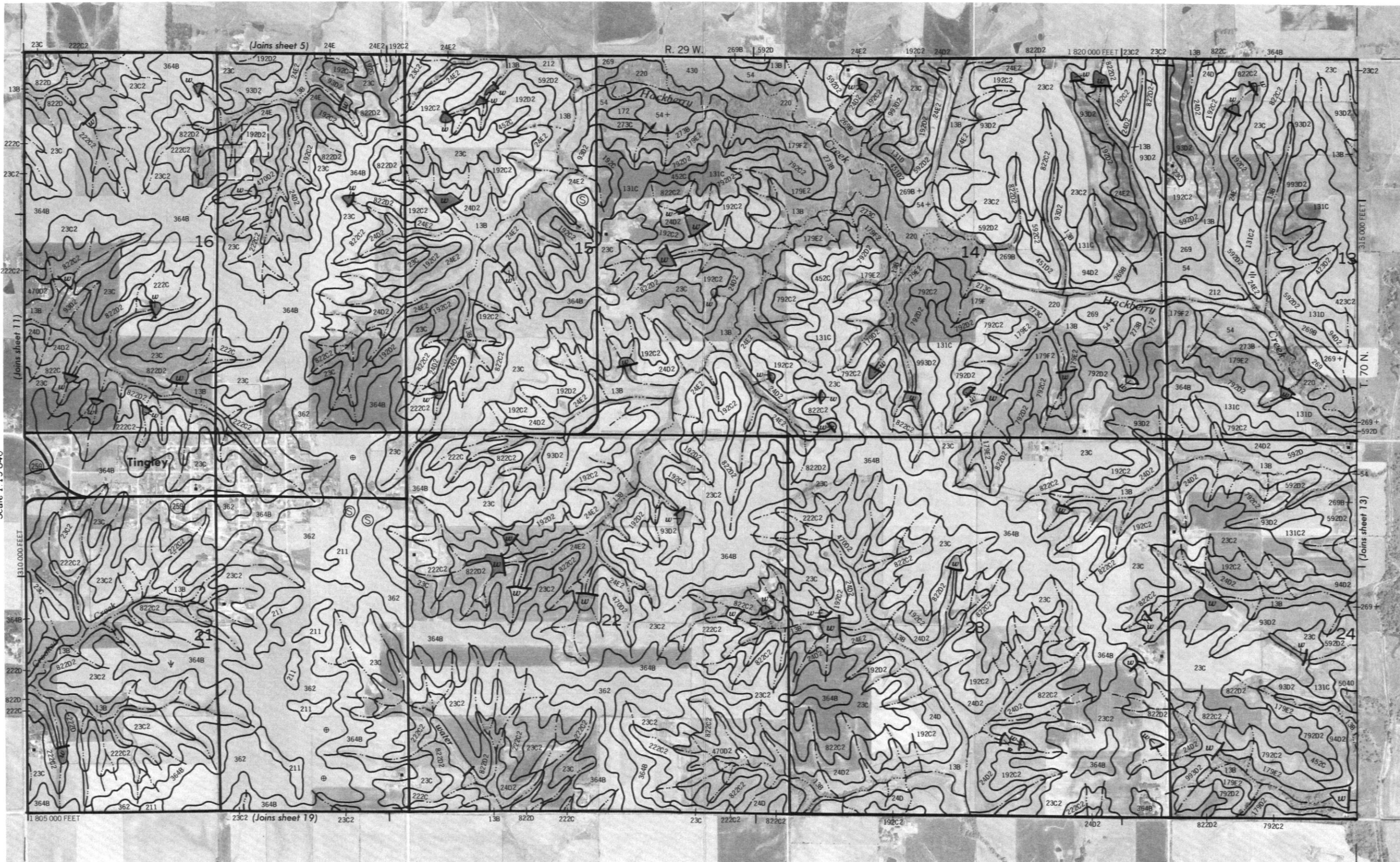






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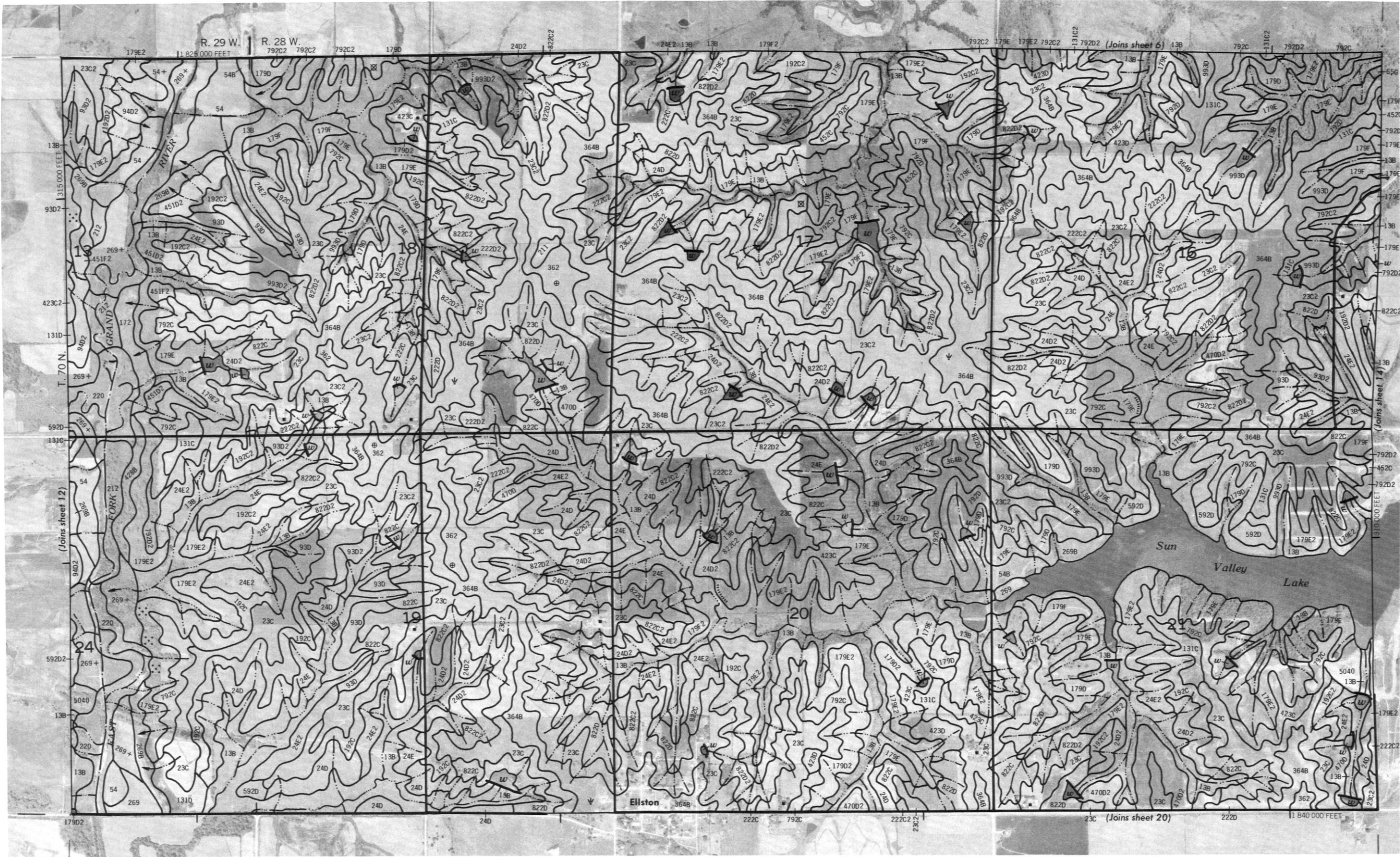


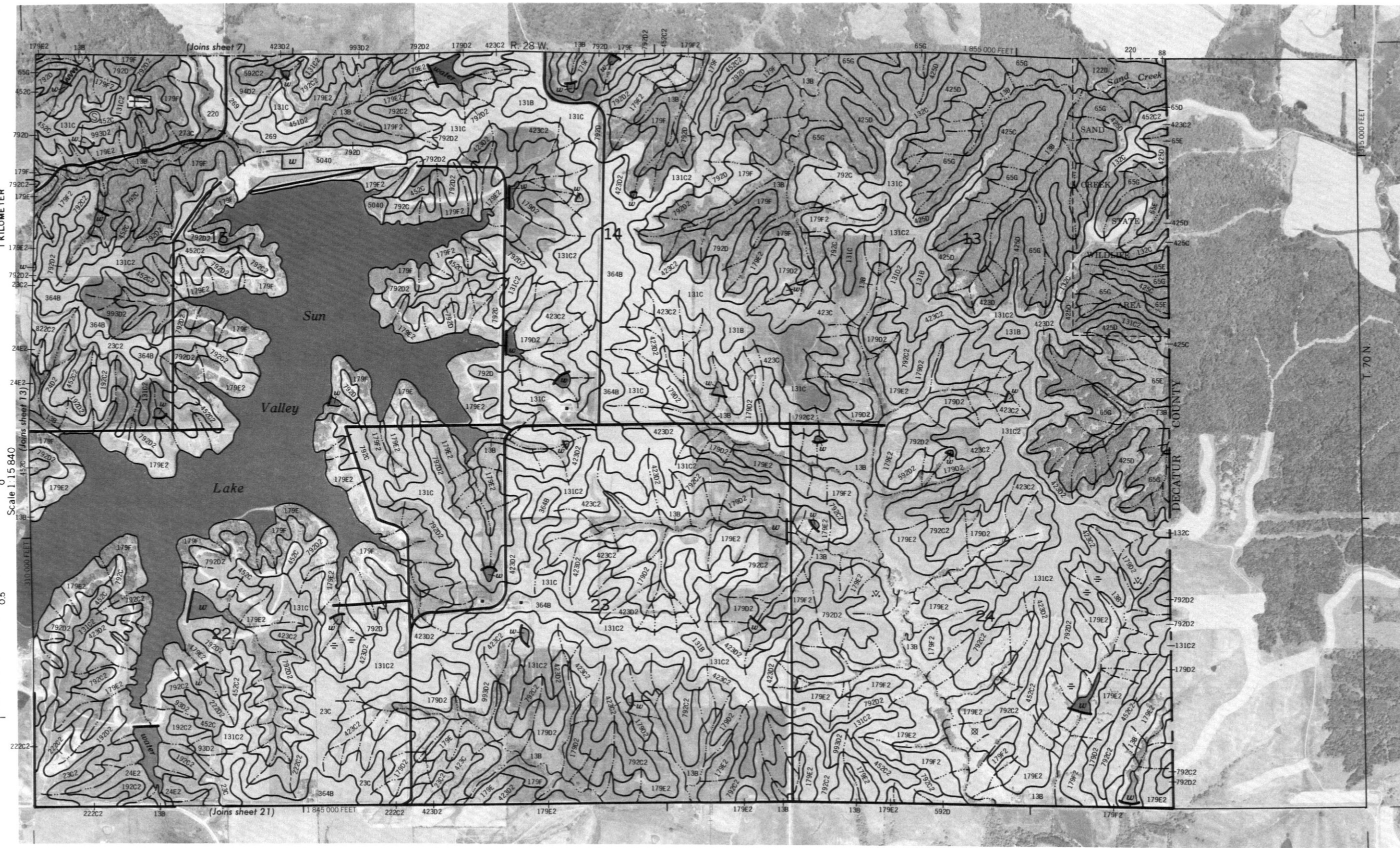


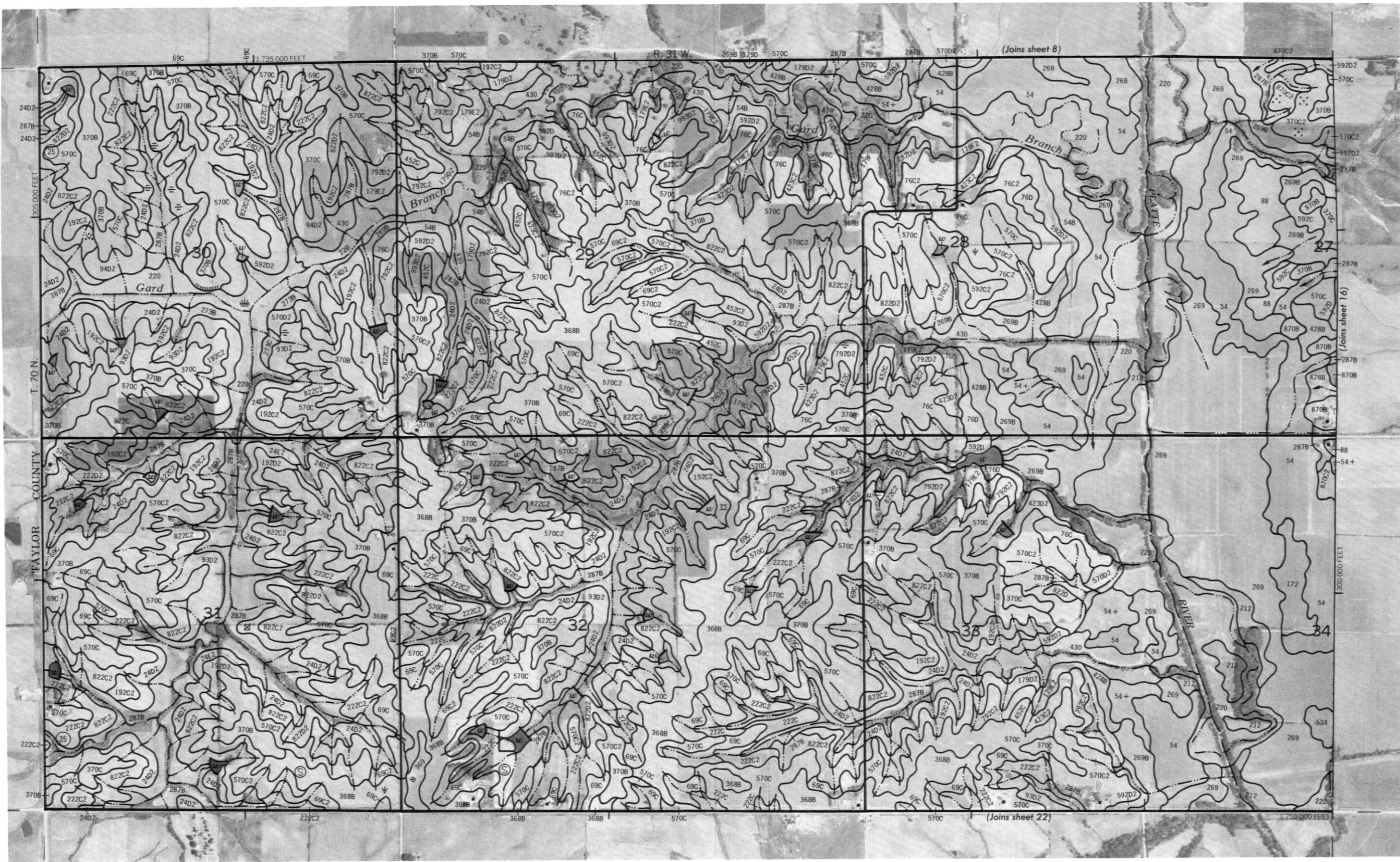
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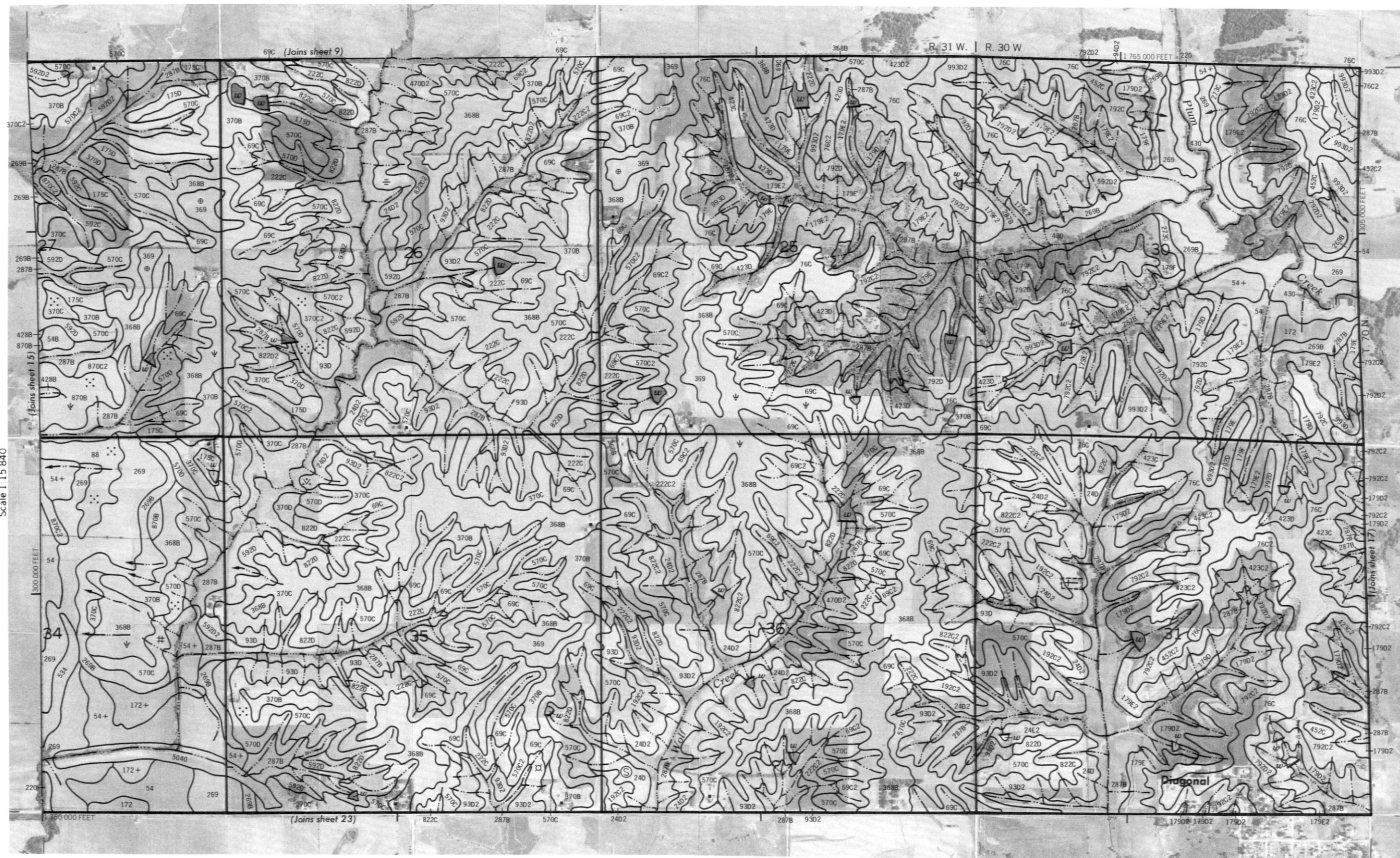
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Coordinate grid ticks and land division corners, if shown, are approximately positioned.



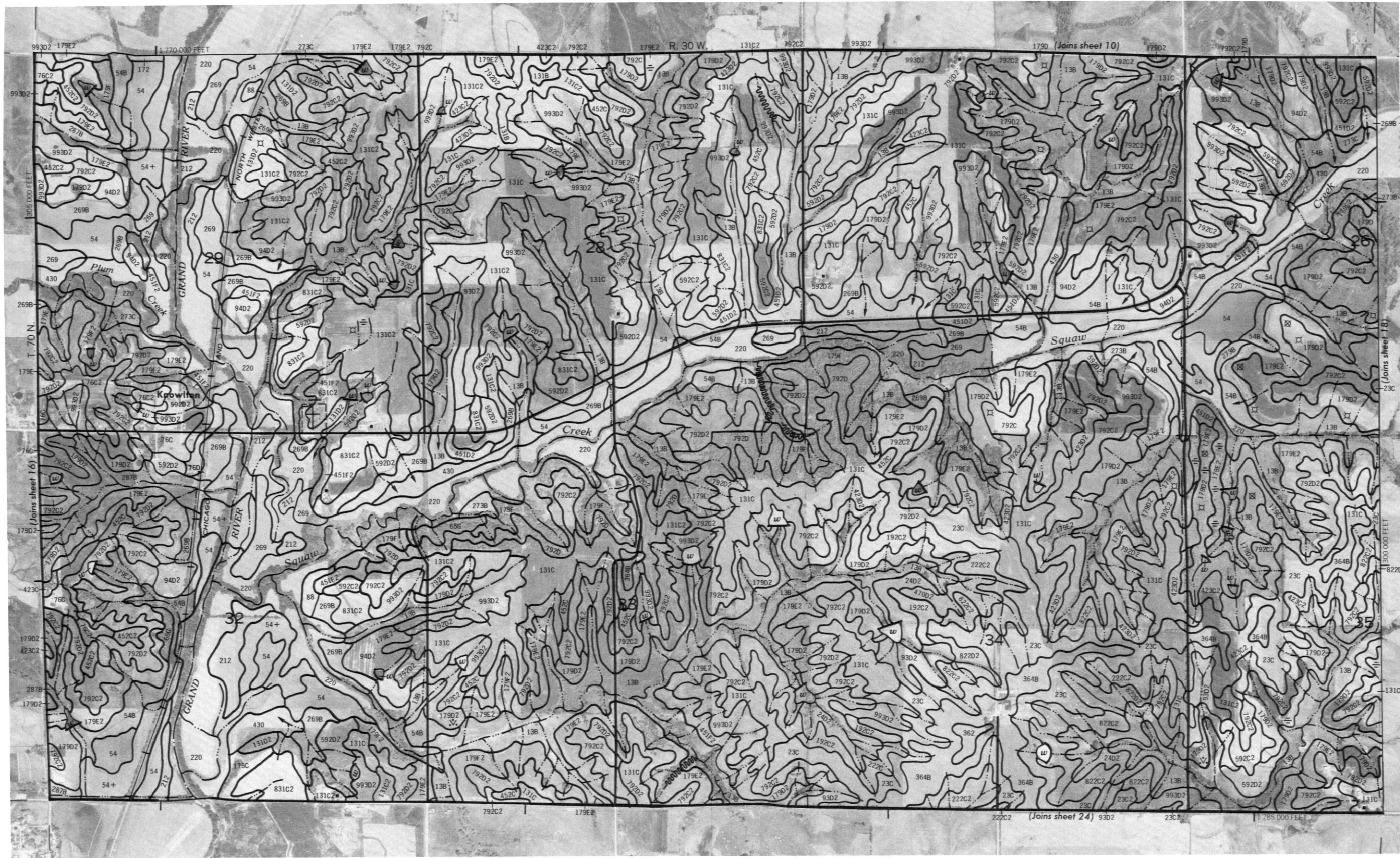






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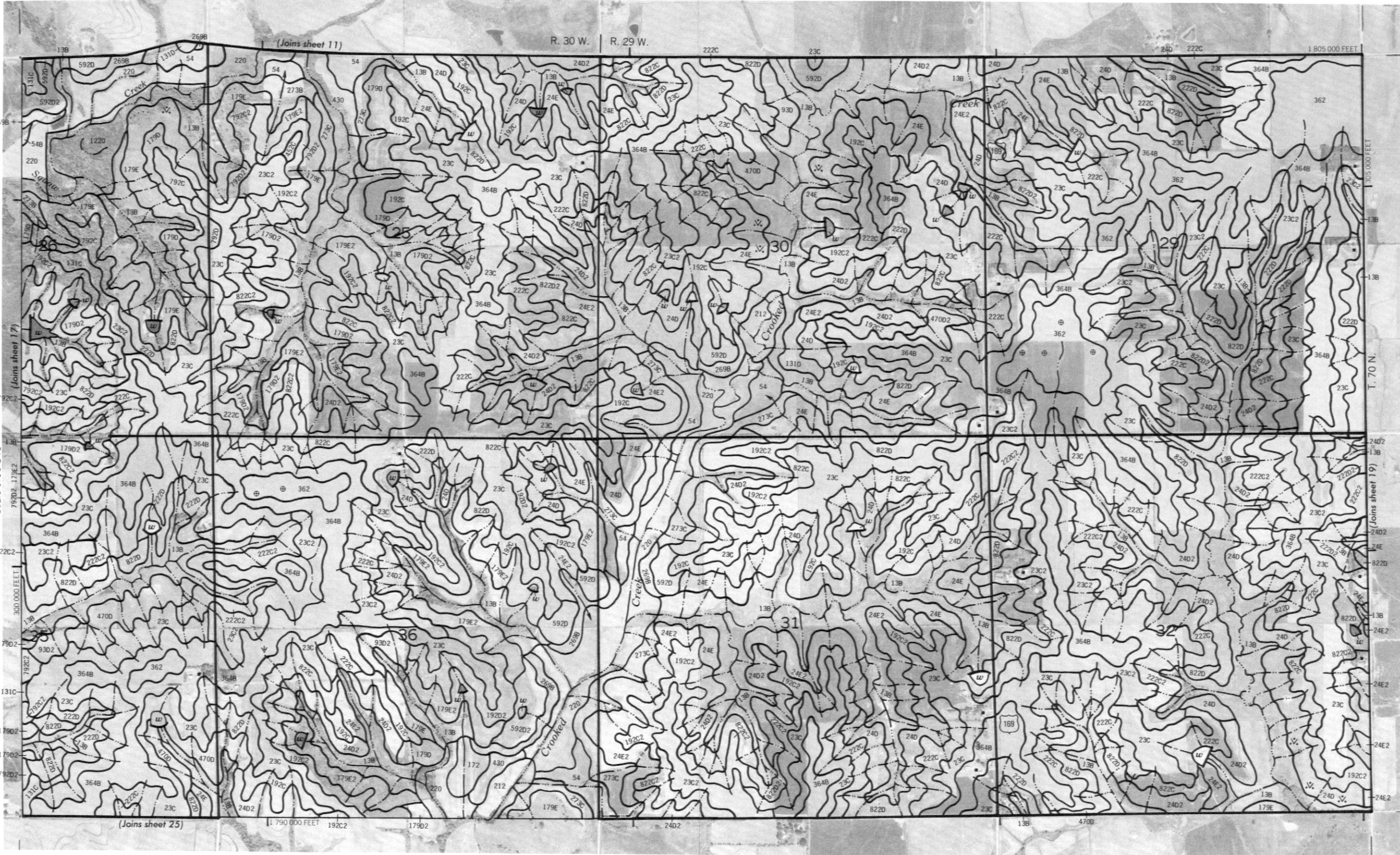
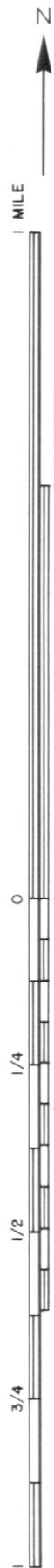
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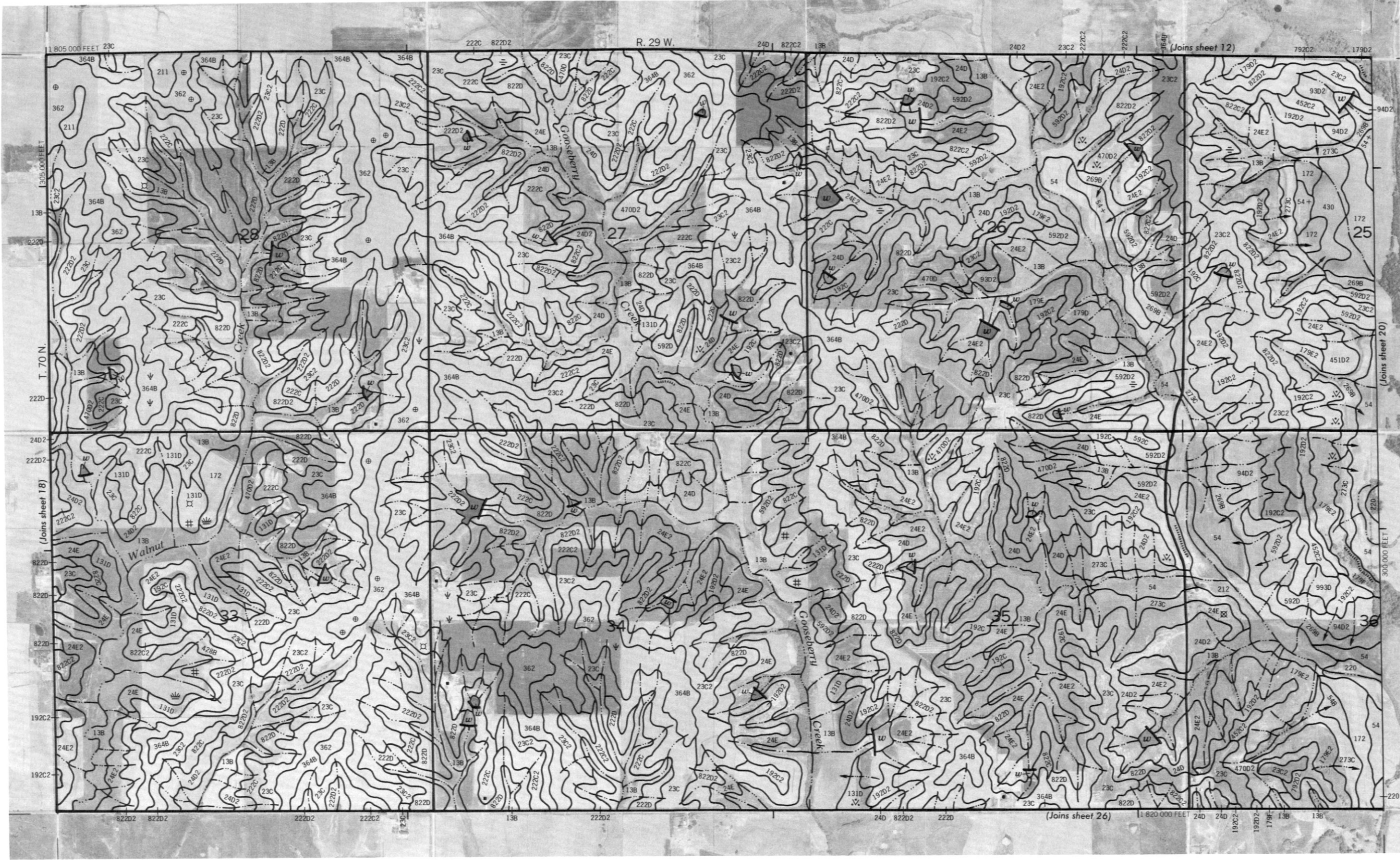
1 KILOMETER

Scale 1:15 840



This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

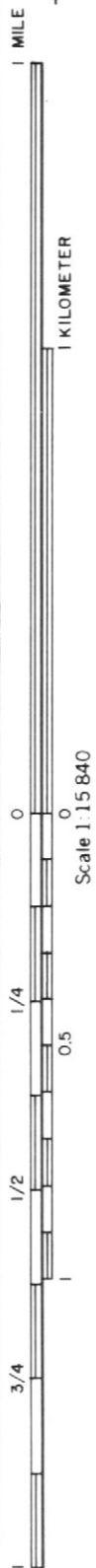
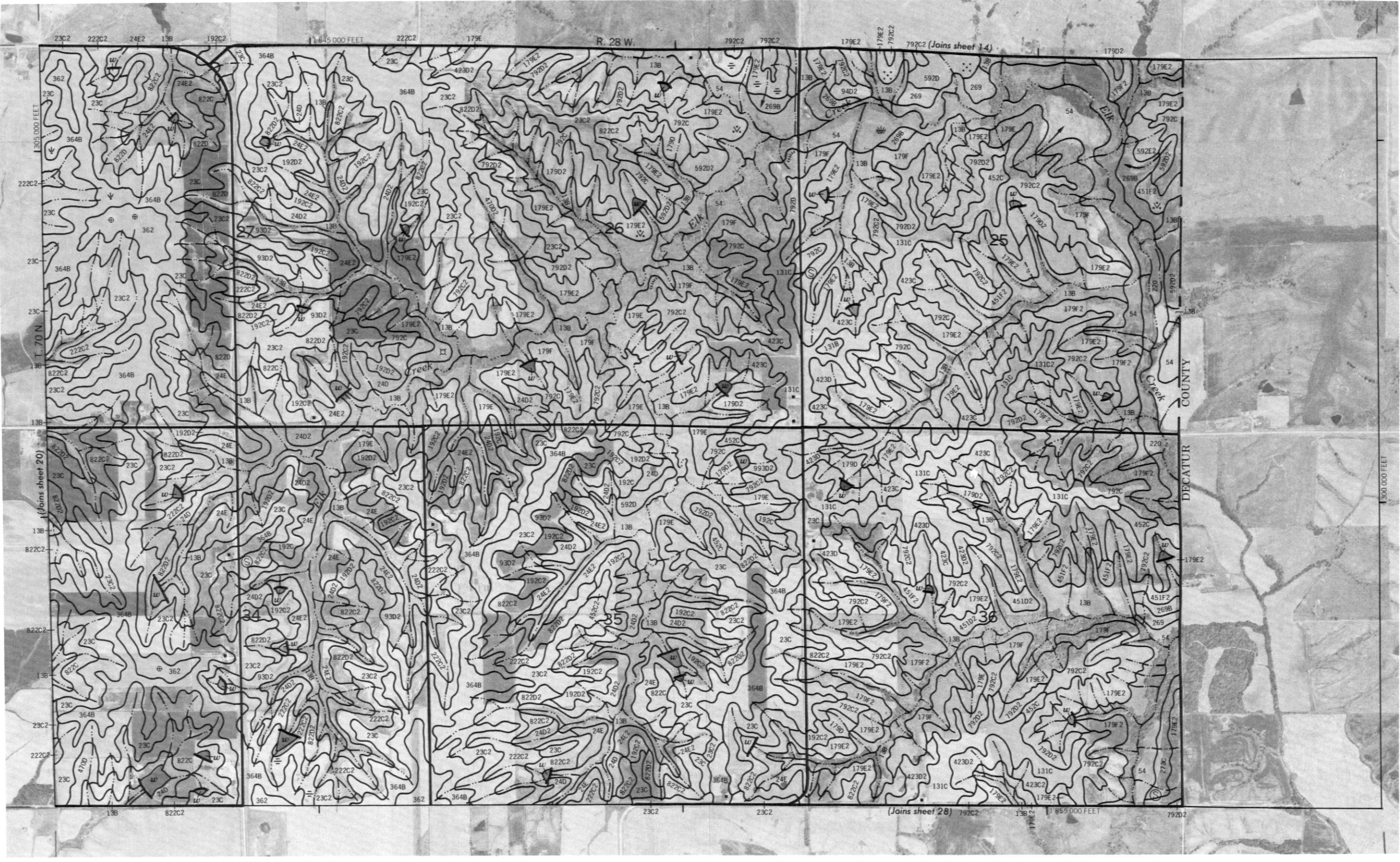
Coordinate grid ticks and land division corners, if shown, are approximately positioned.





RINGGOLD COUNTY, IOWA NO. 21

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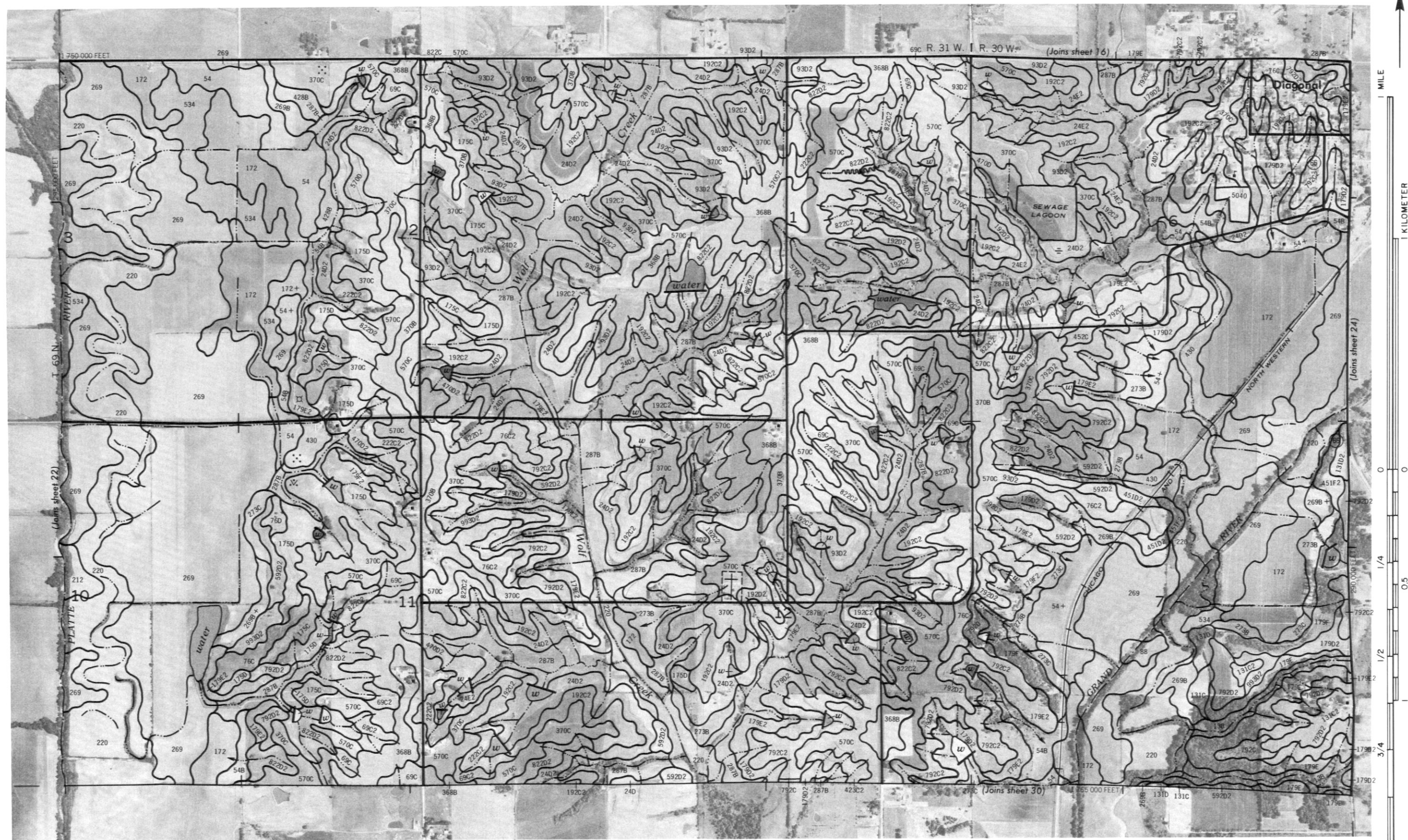
570C

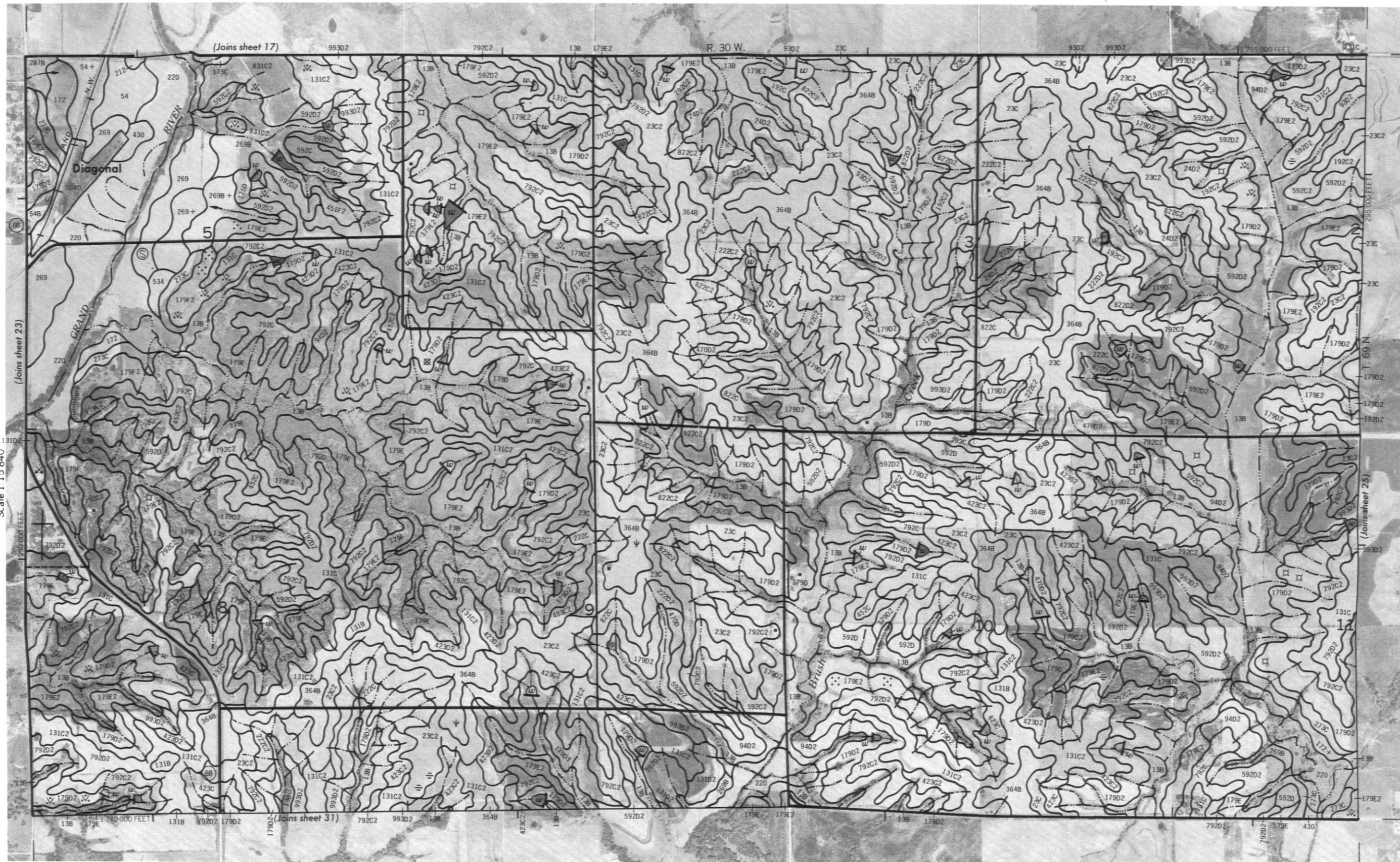
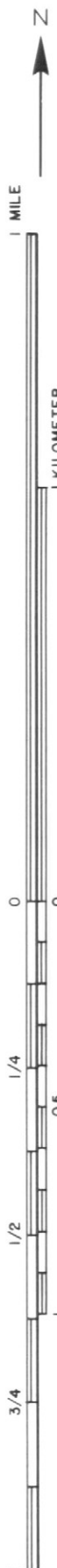
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RINGGOLD COUNTY, IOWA NO. 22

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1 KILOMETER

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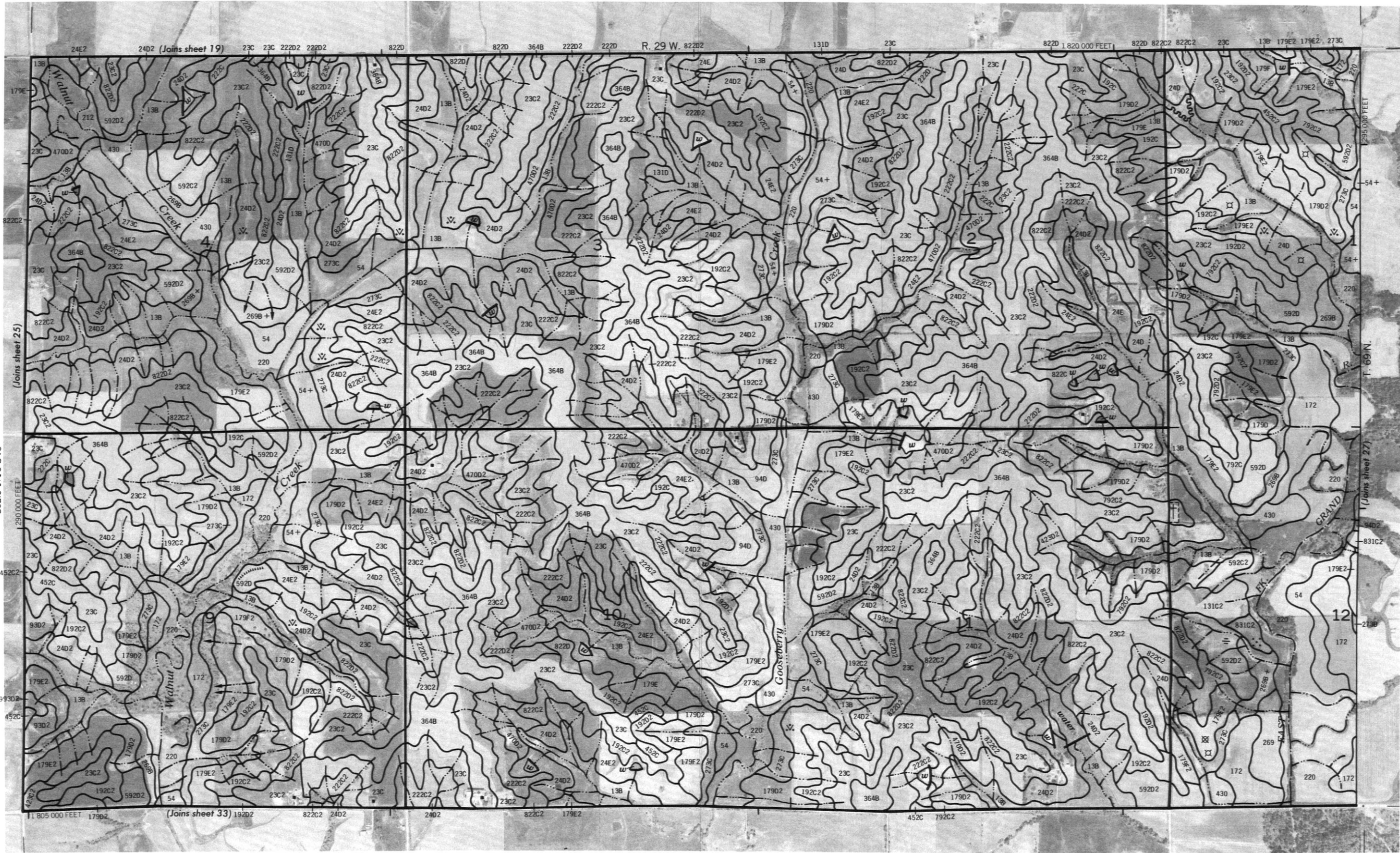
314

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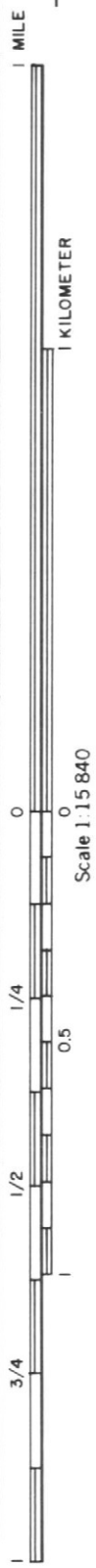
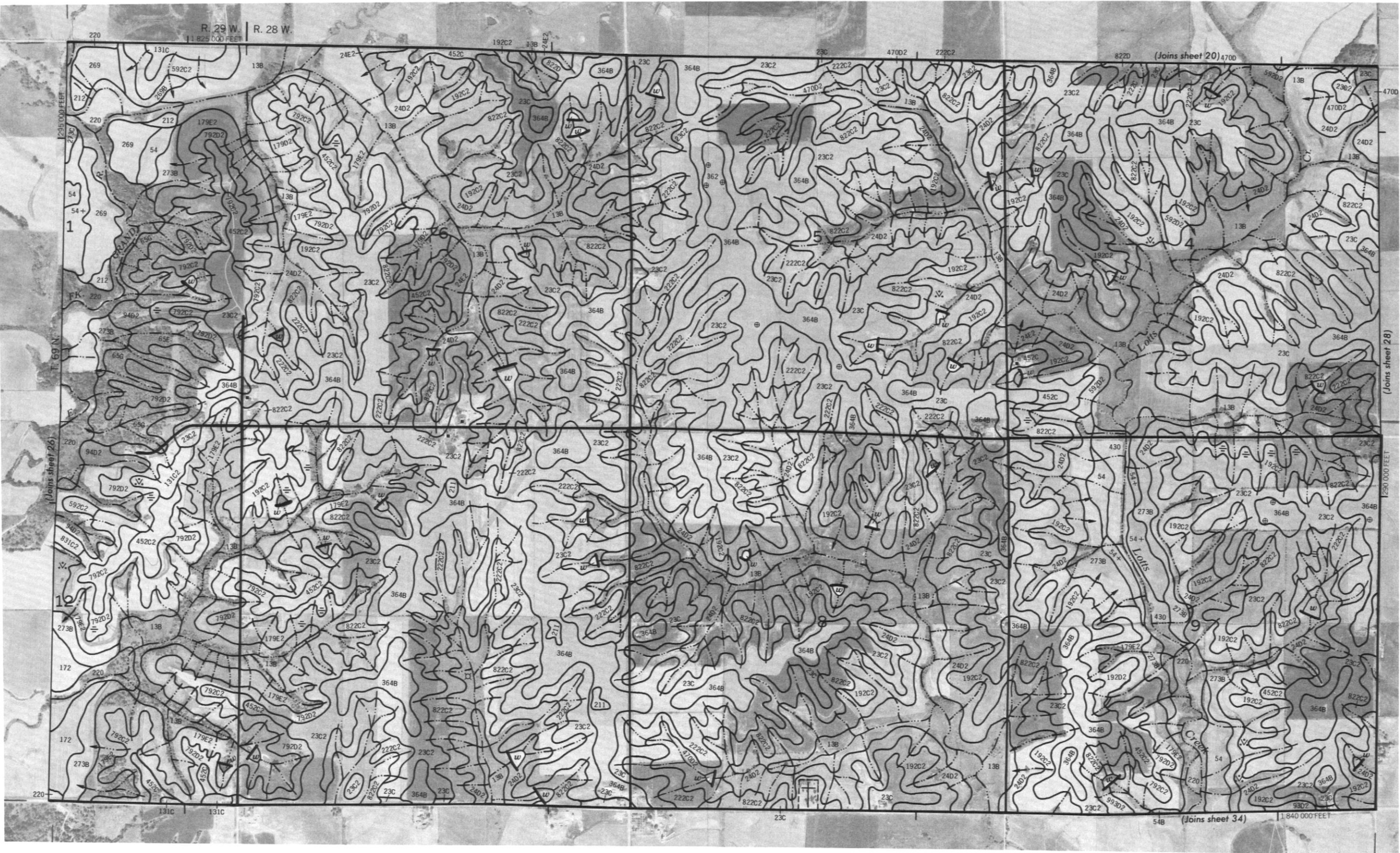
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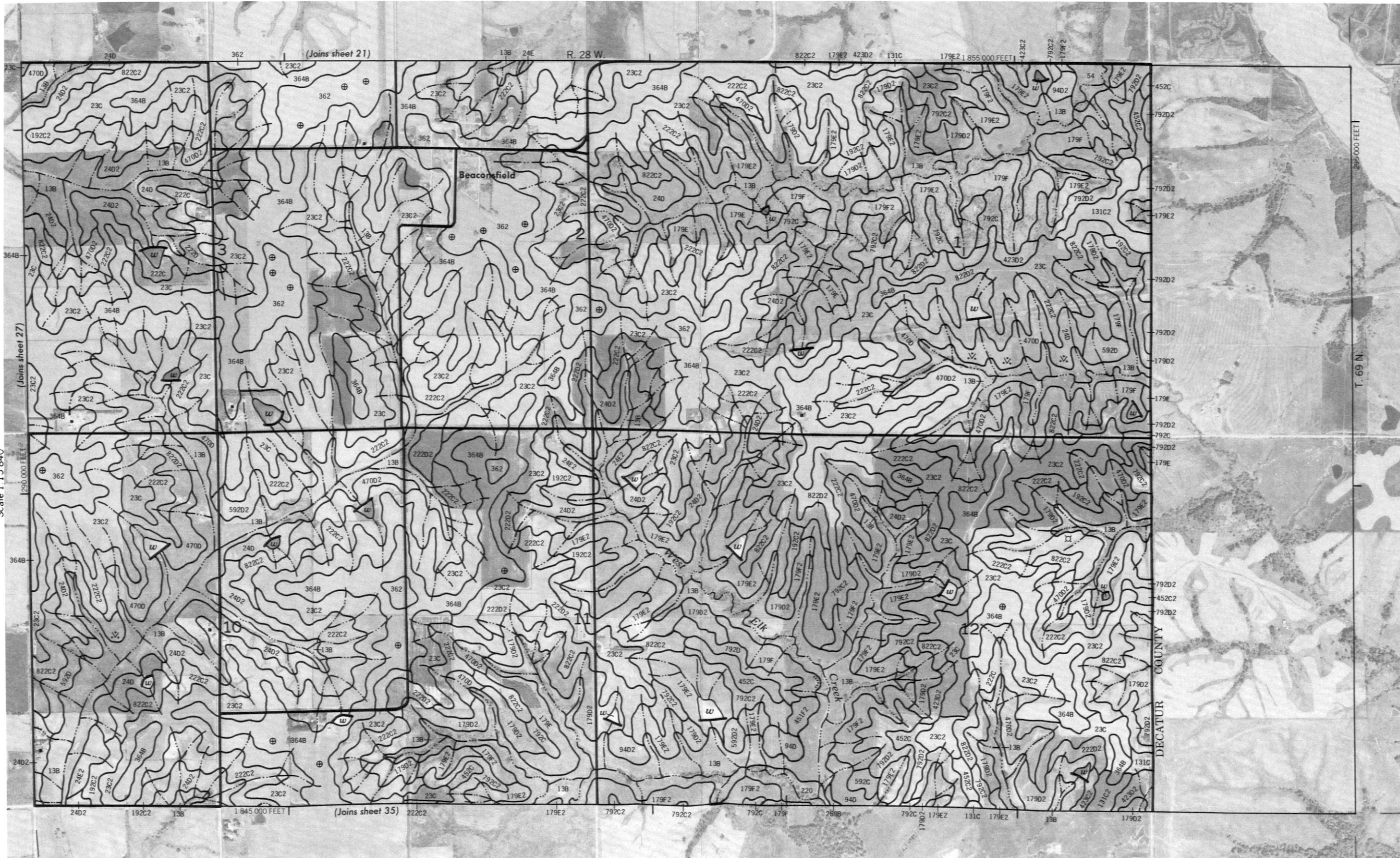
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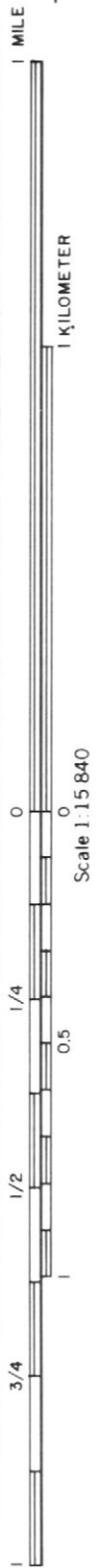
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

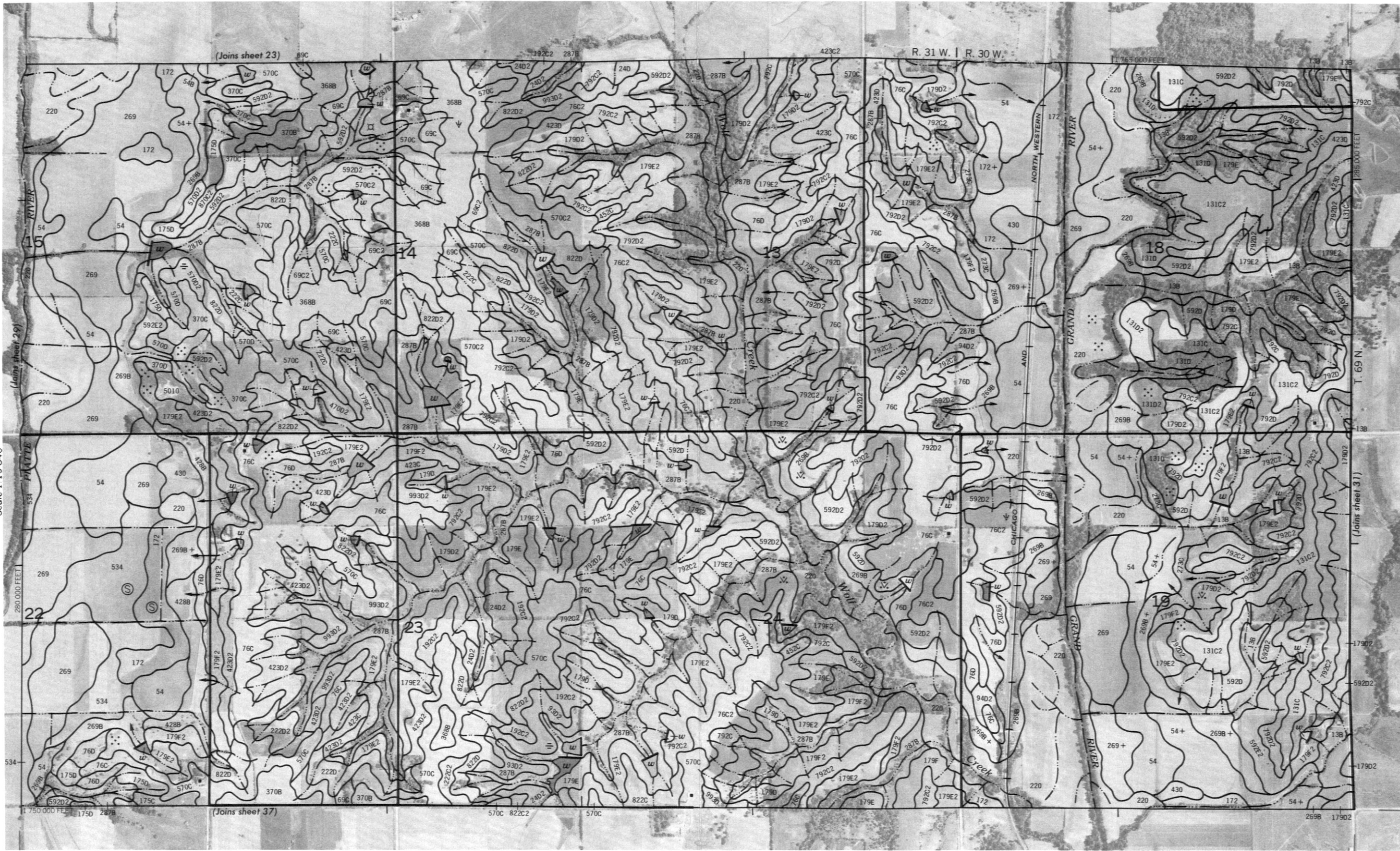
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



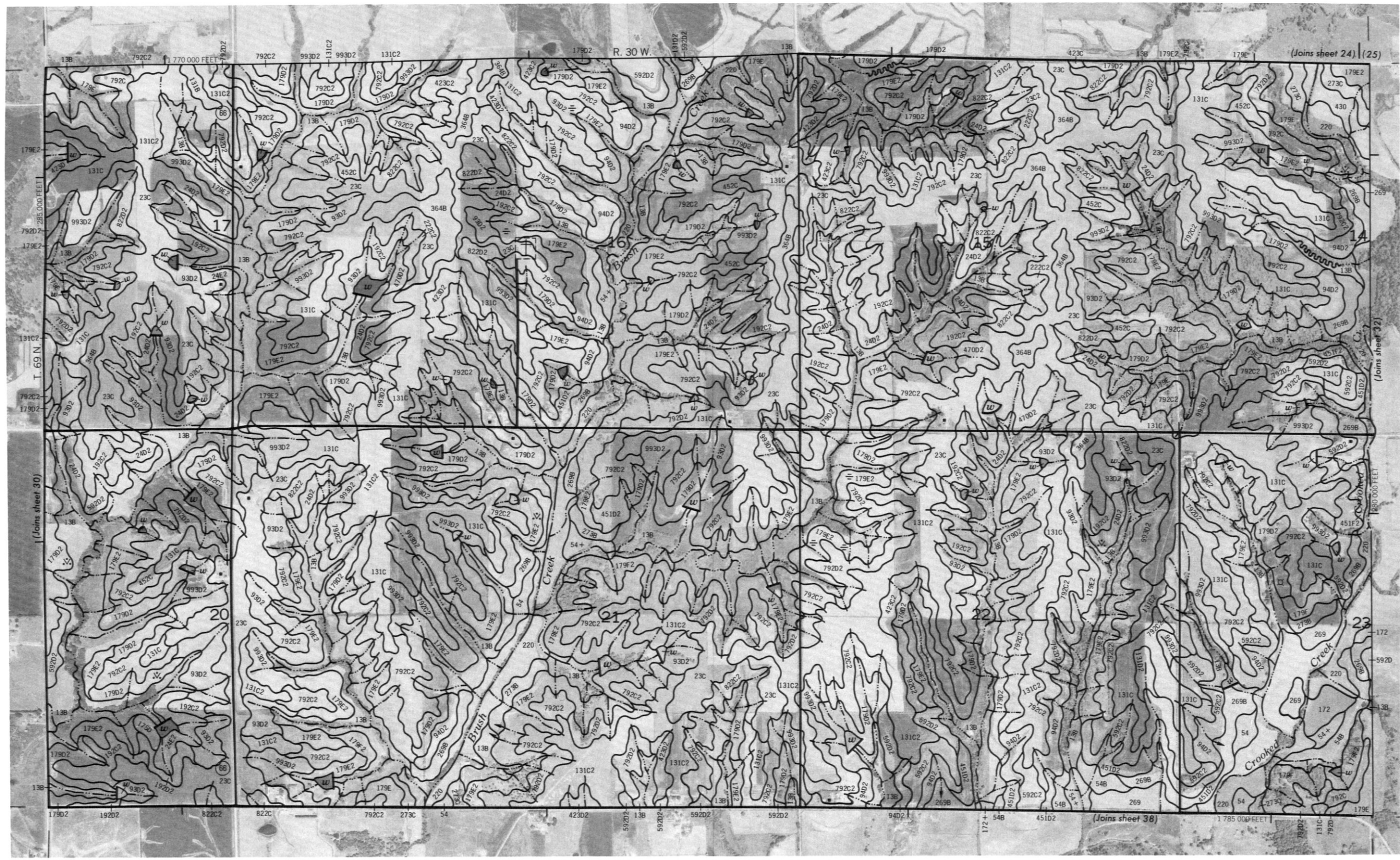


This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





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1 KILOMETER

Scale 1:15 840

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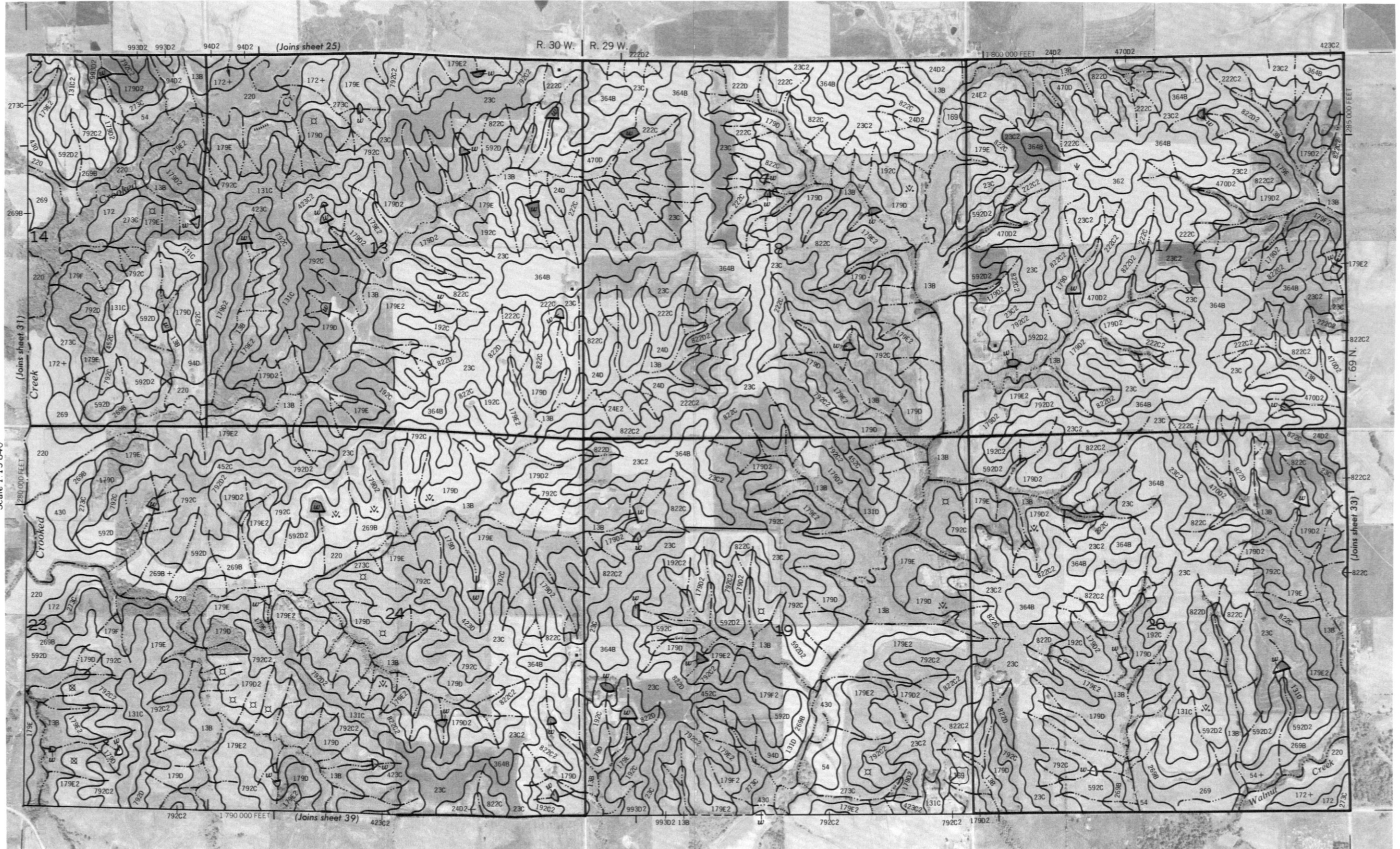
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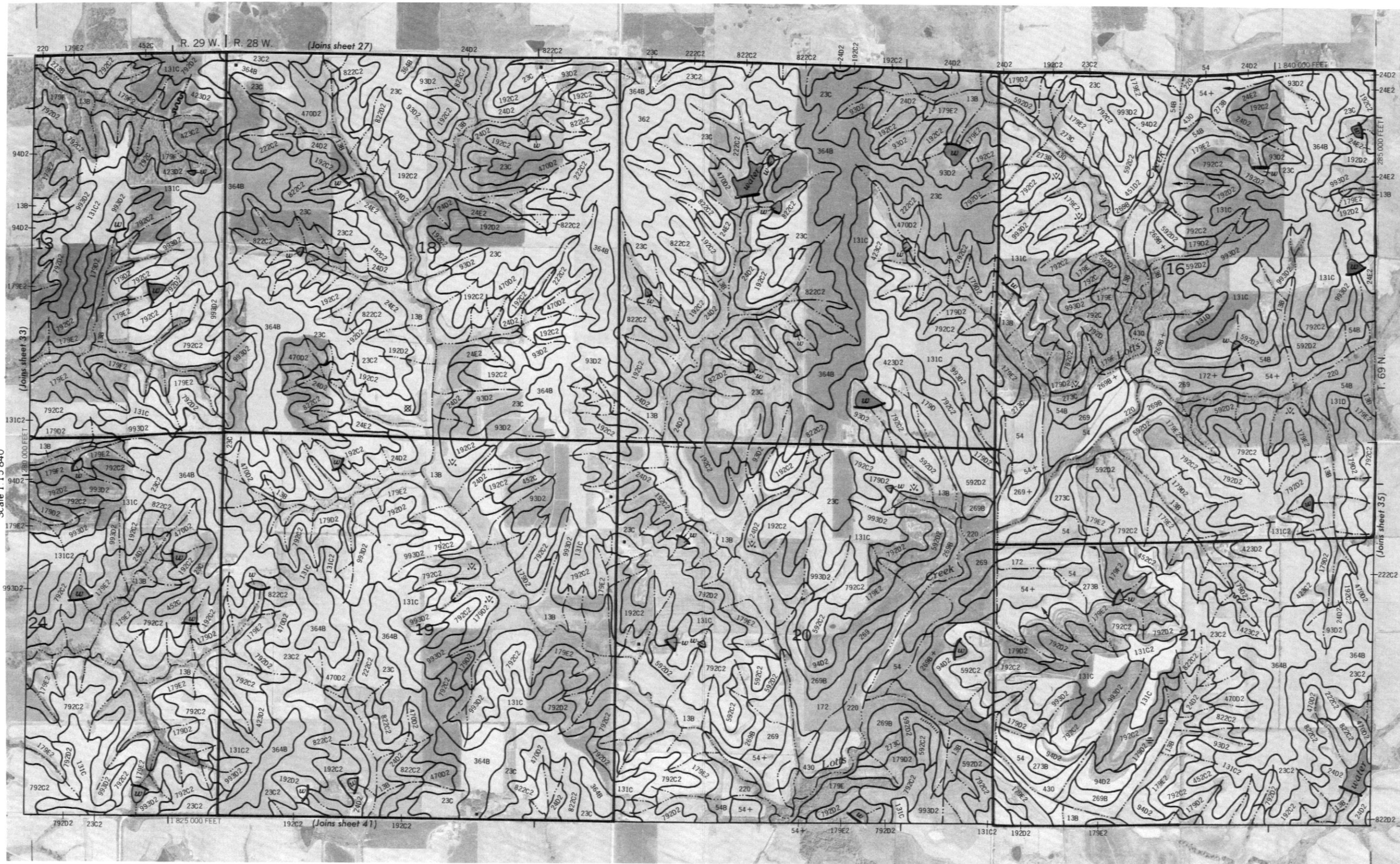
11



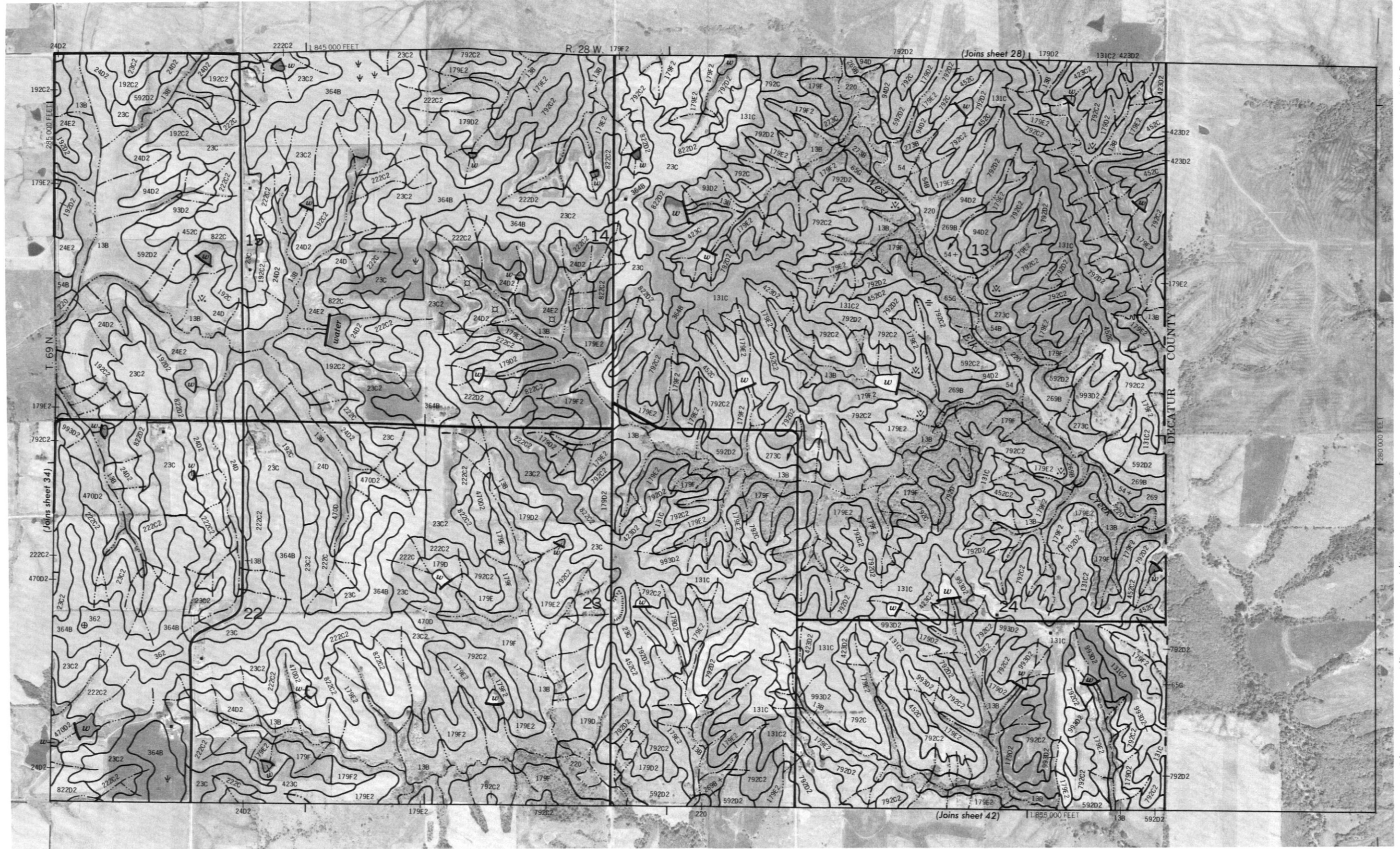
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This soil survey map is compiled on 1:37,500 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

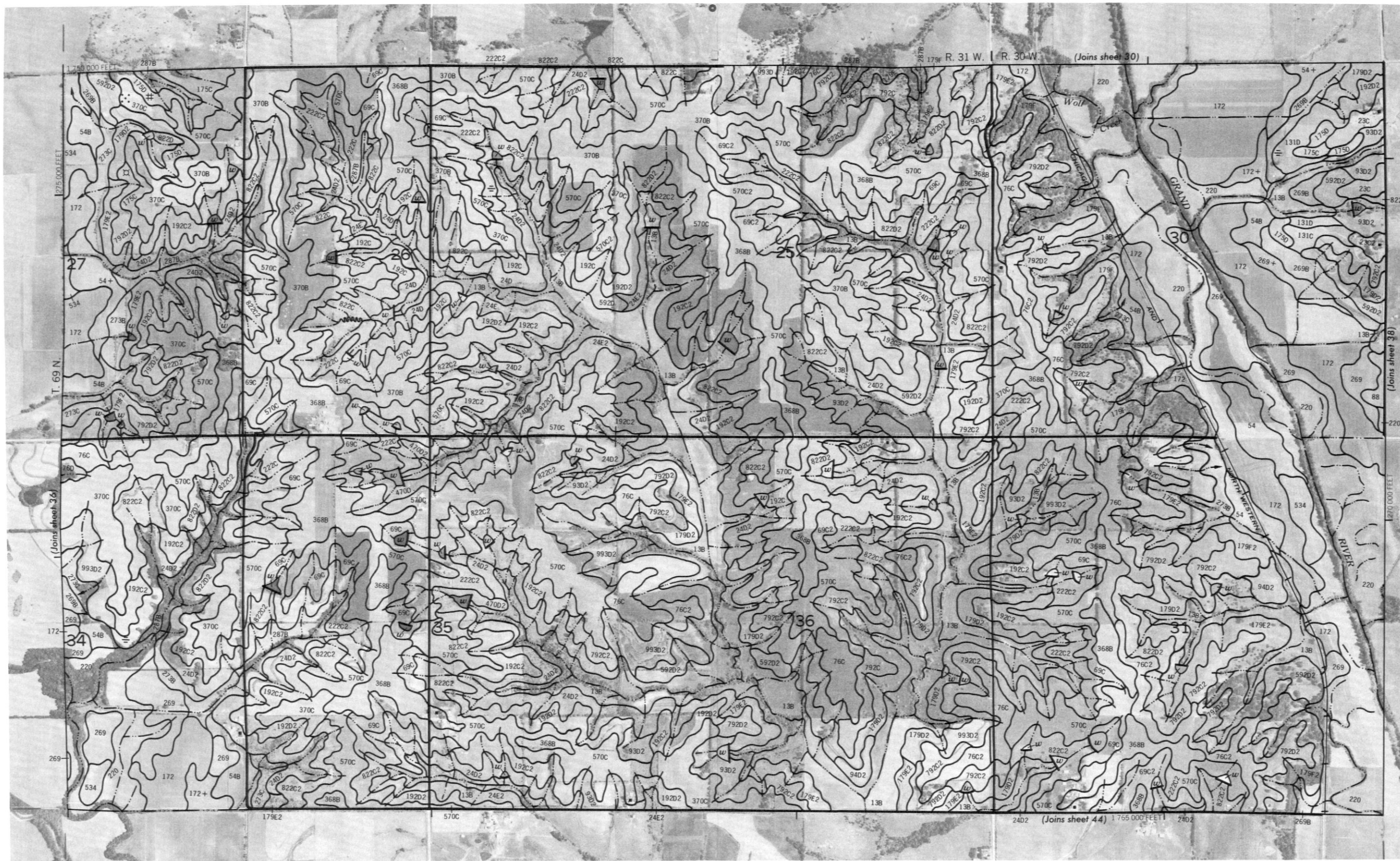
RINGGOLD COUNTY, IOWA, NO. 22

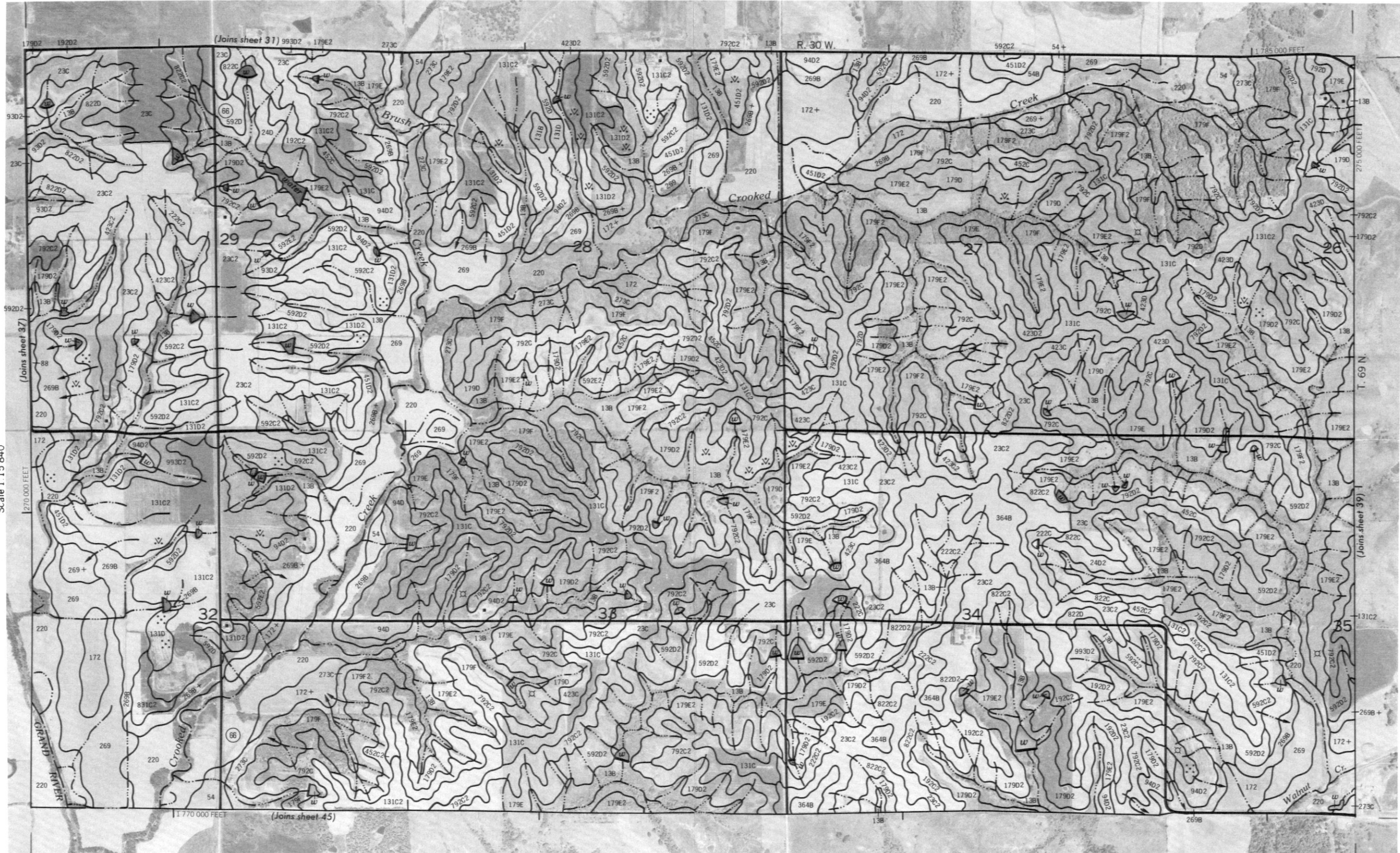


This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This soil survey map is compiled on 1979 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





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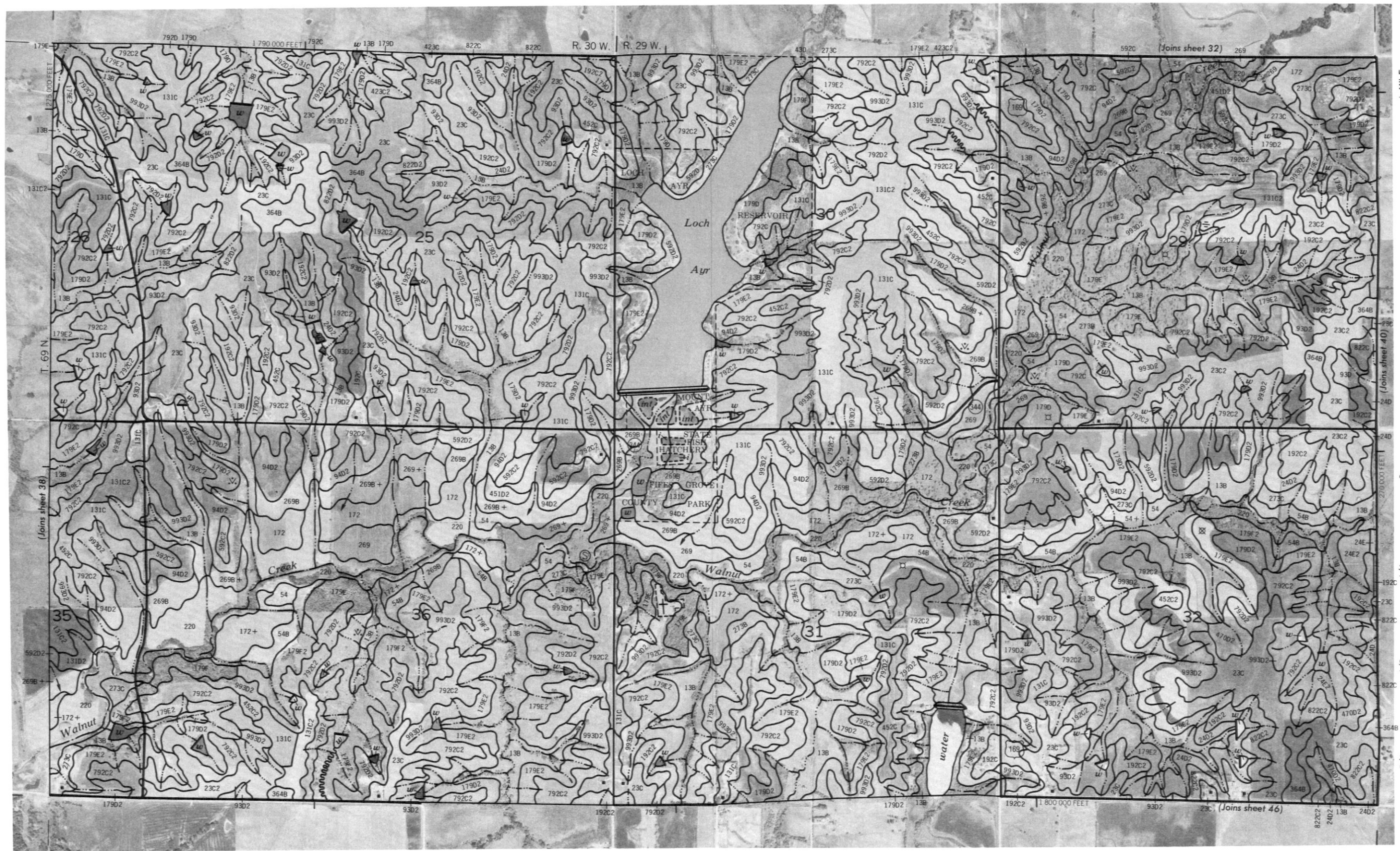
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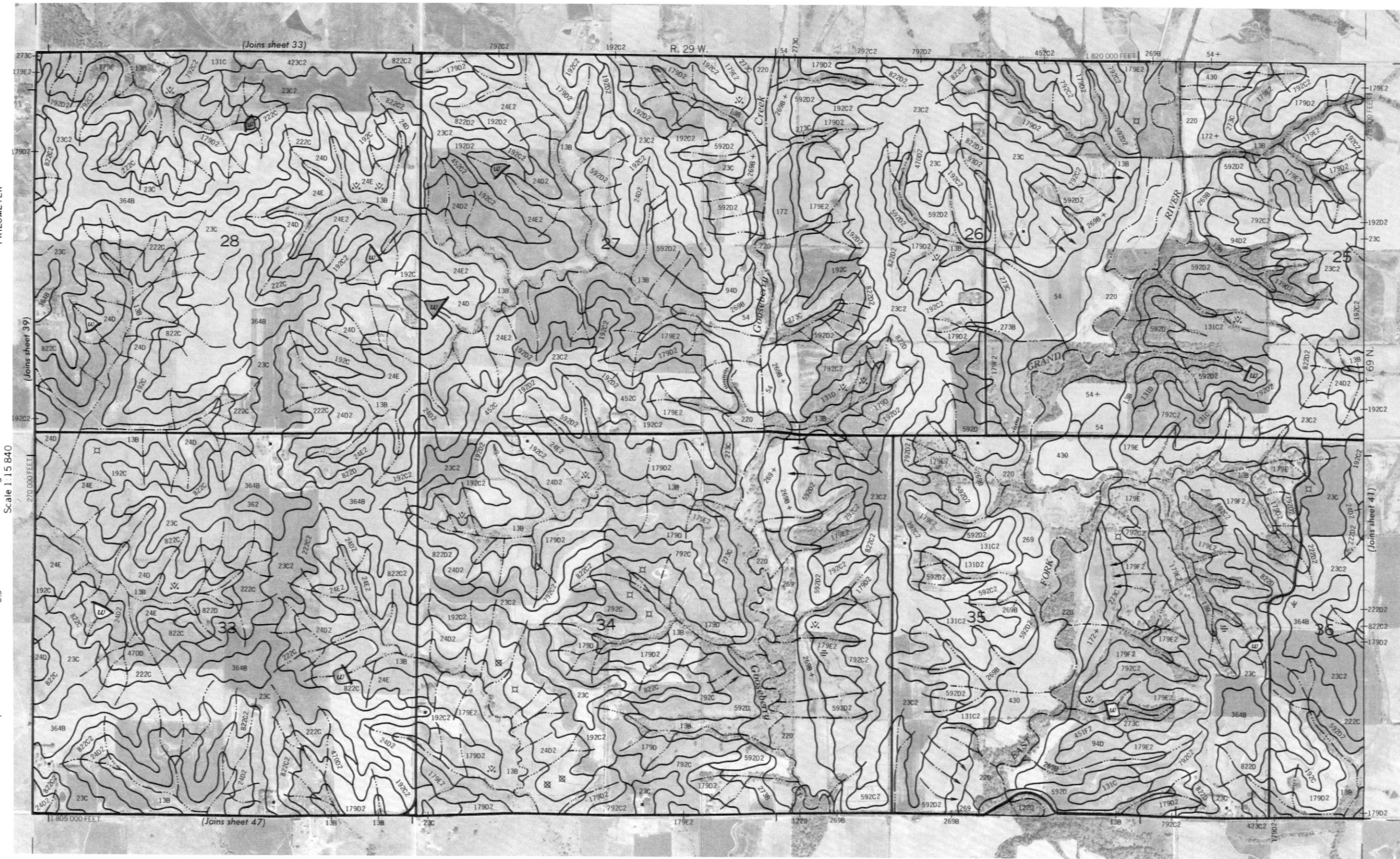
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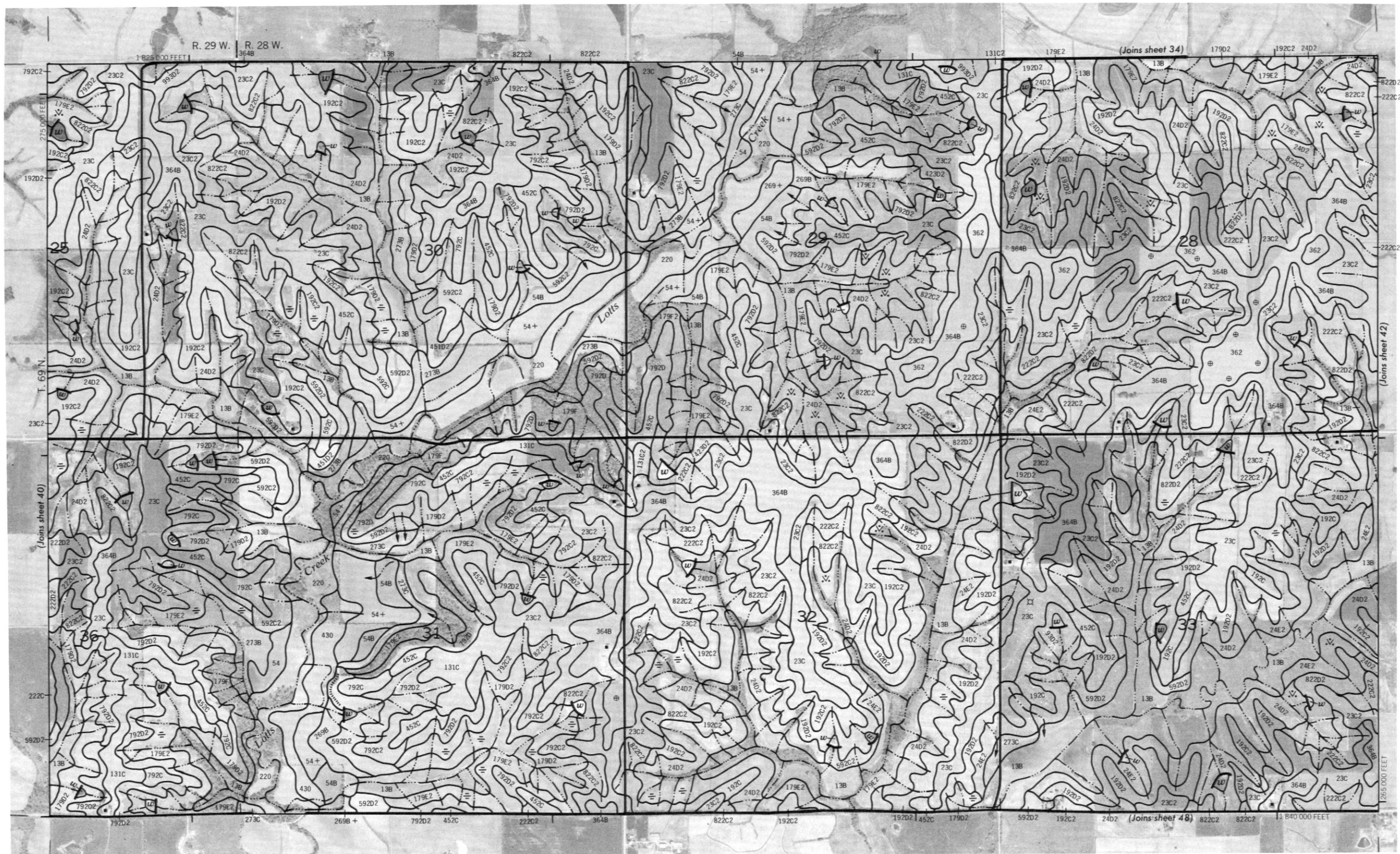
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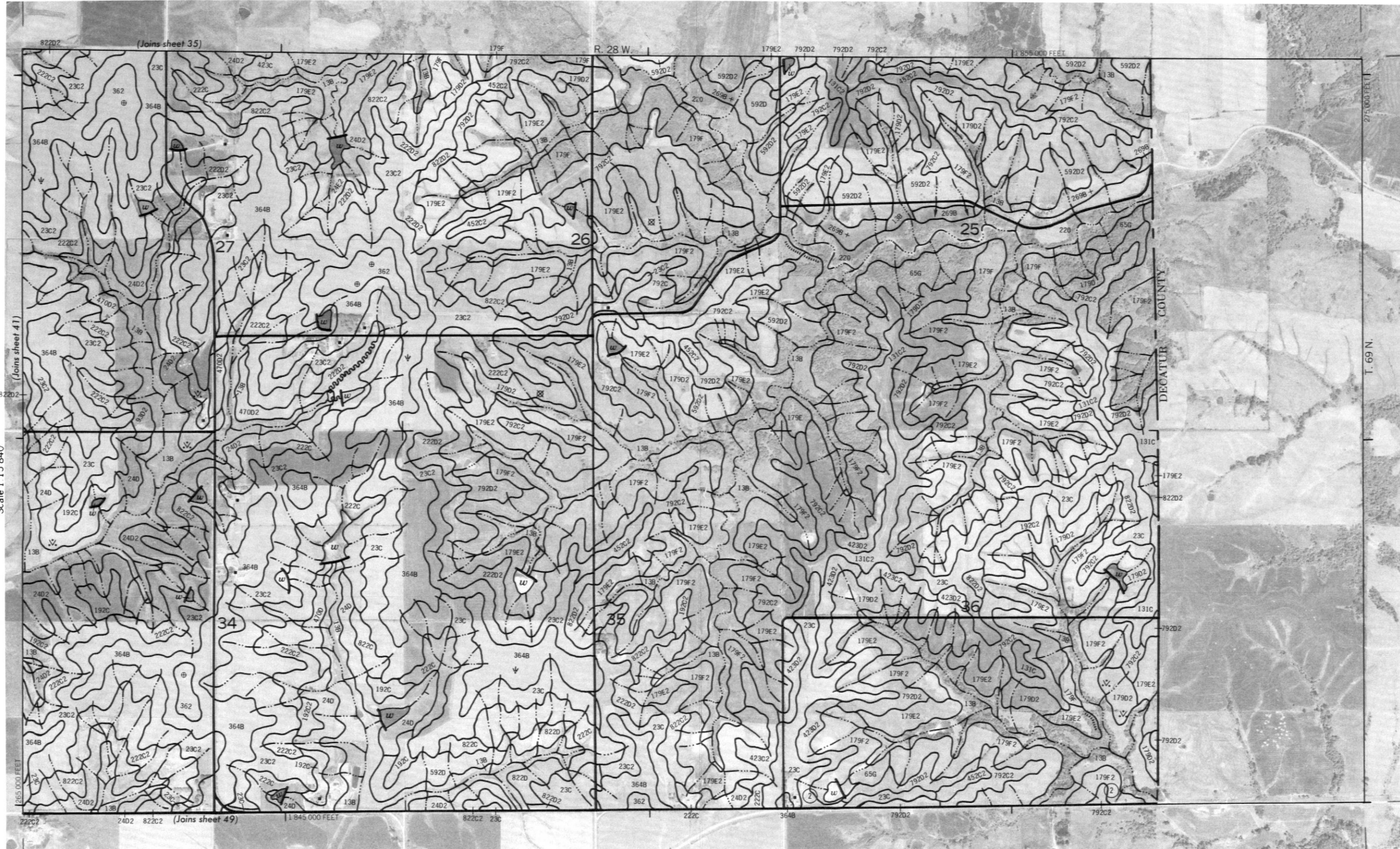
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





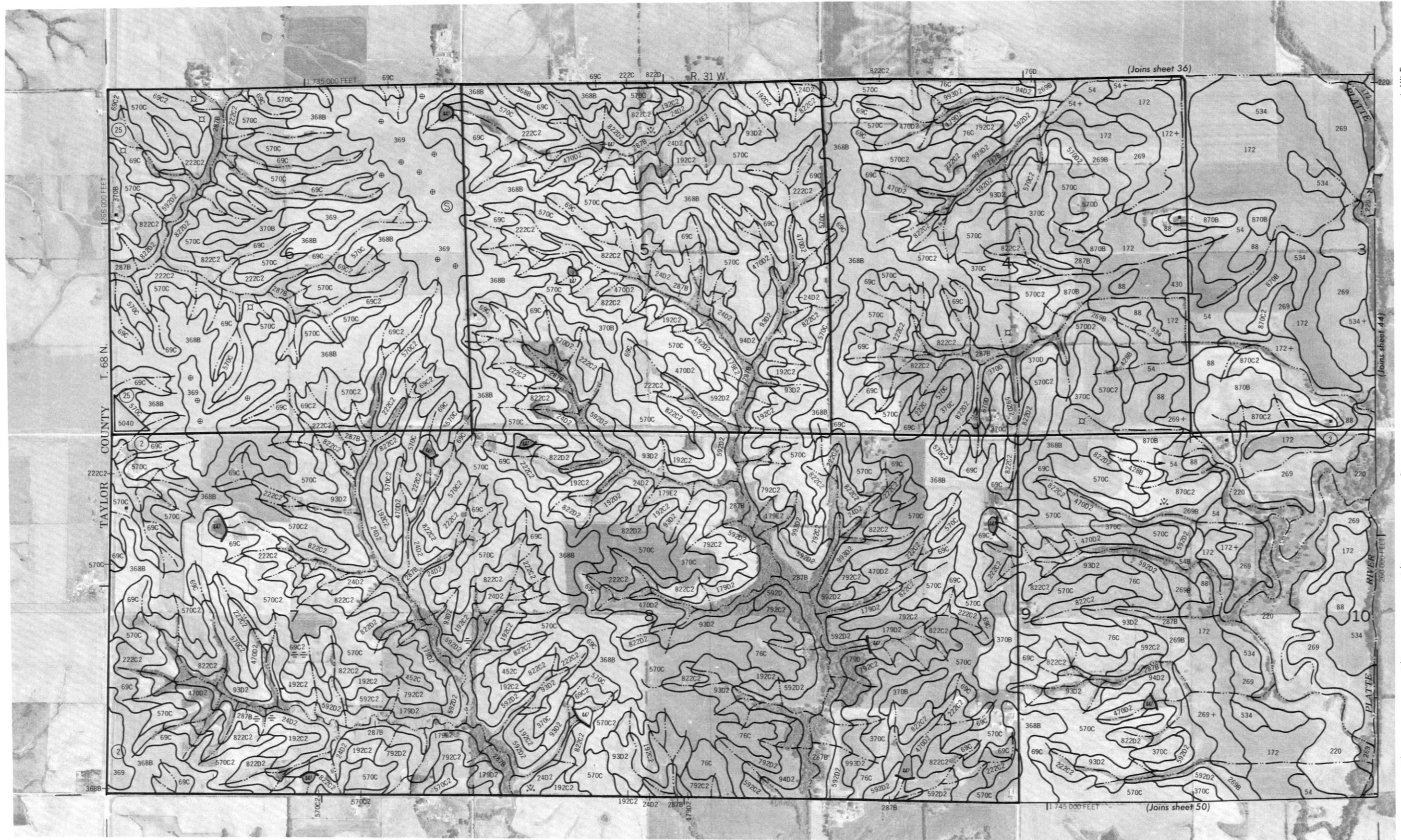
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies Coordinate grid ticks and land division corners, if shown, are approximately positioned.





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KILOMETER

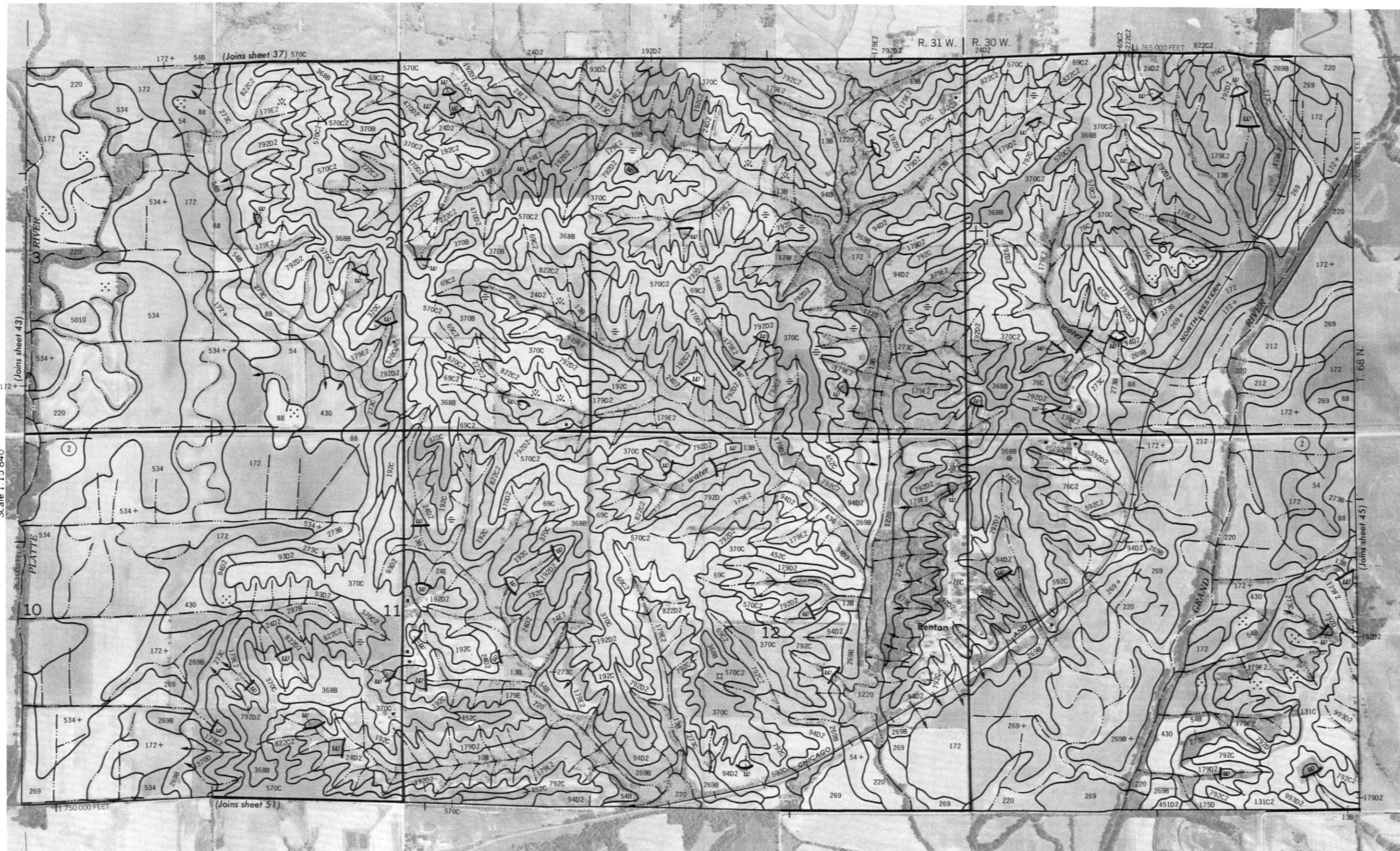
Scale 1:15840

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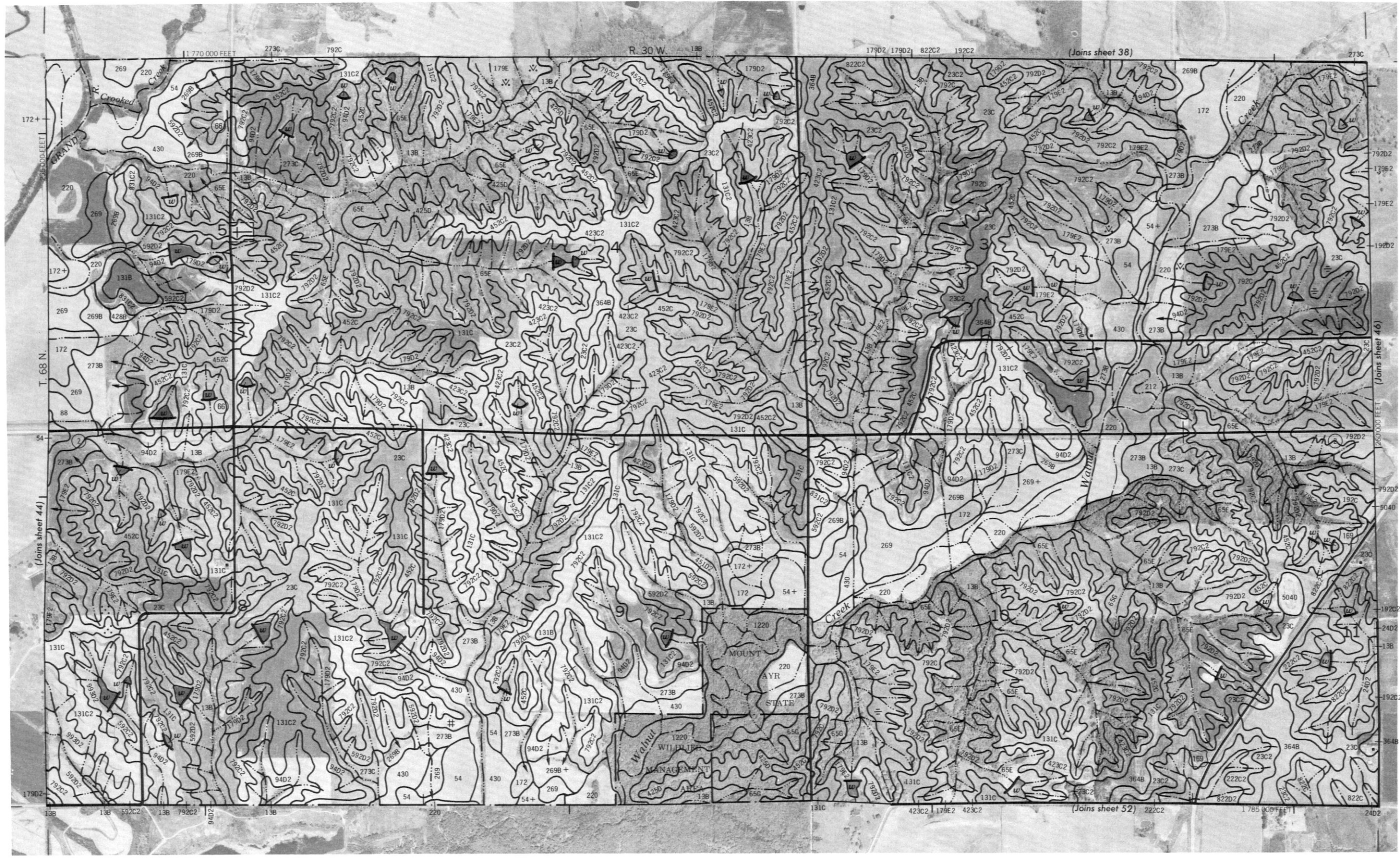
1/2

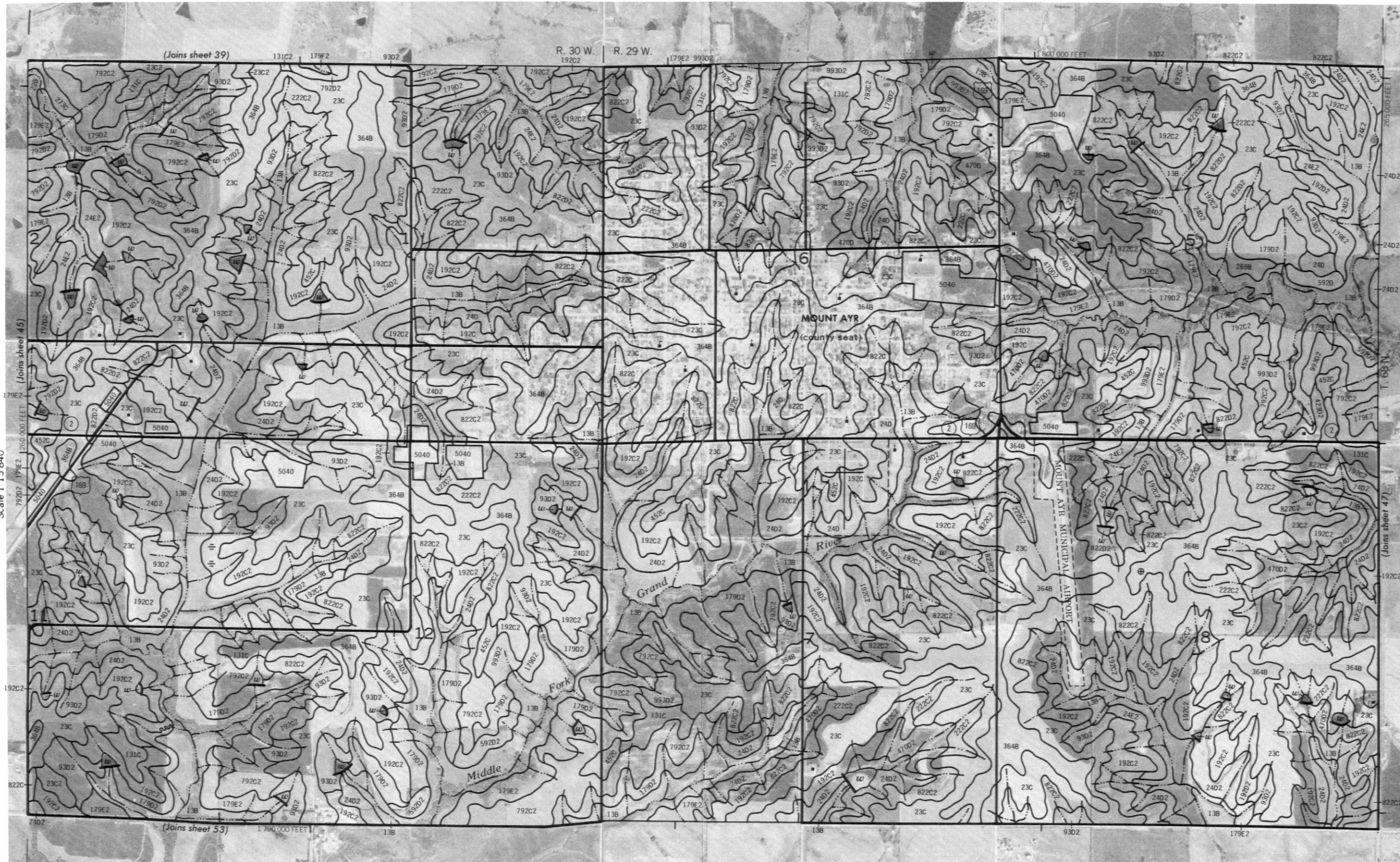
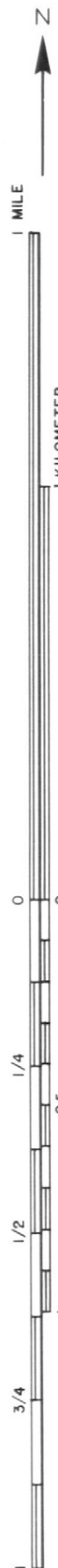
3/4



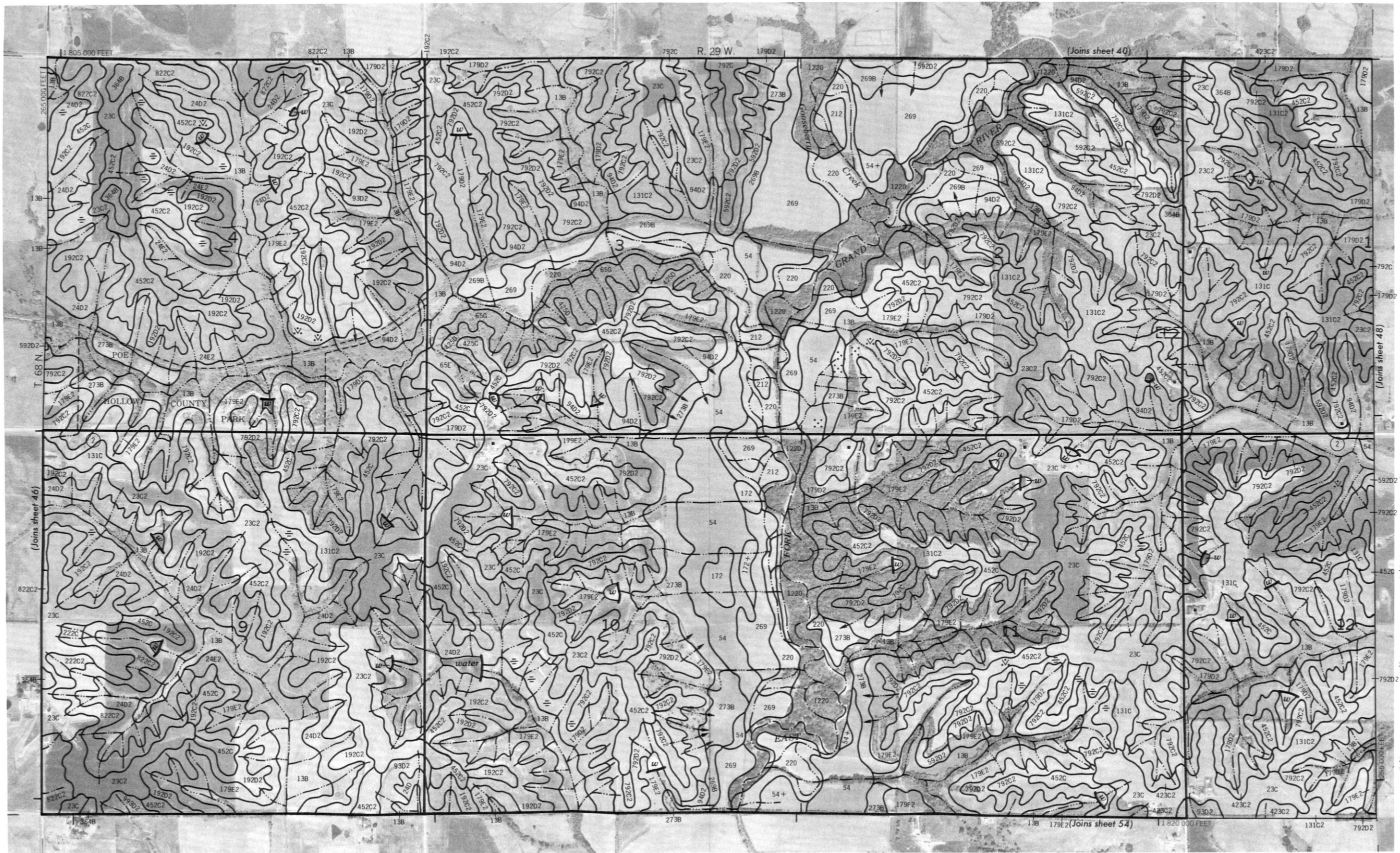
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

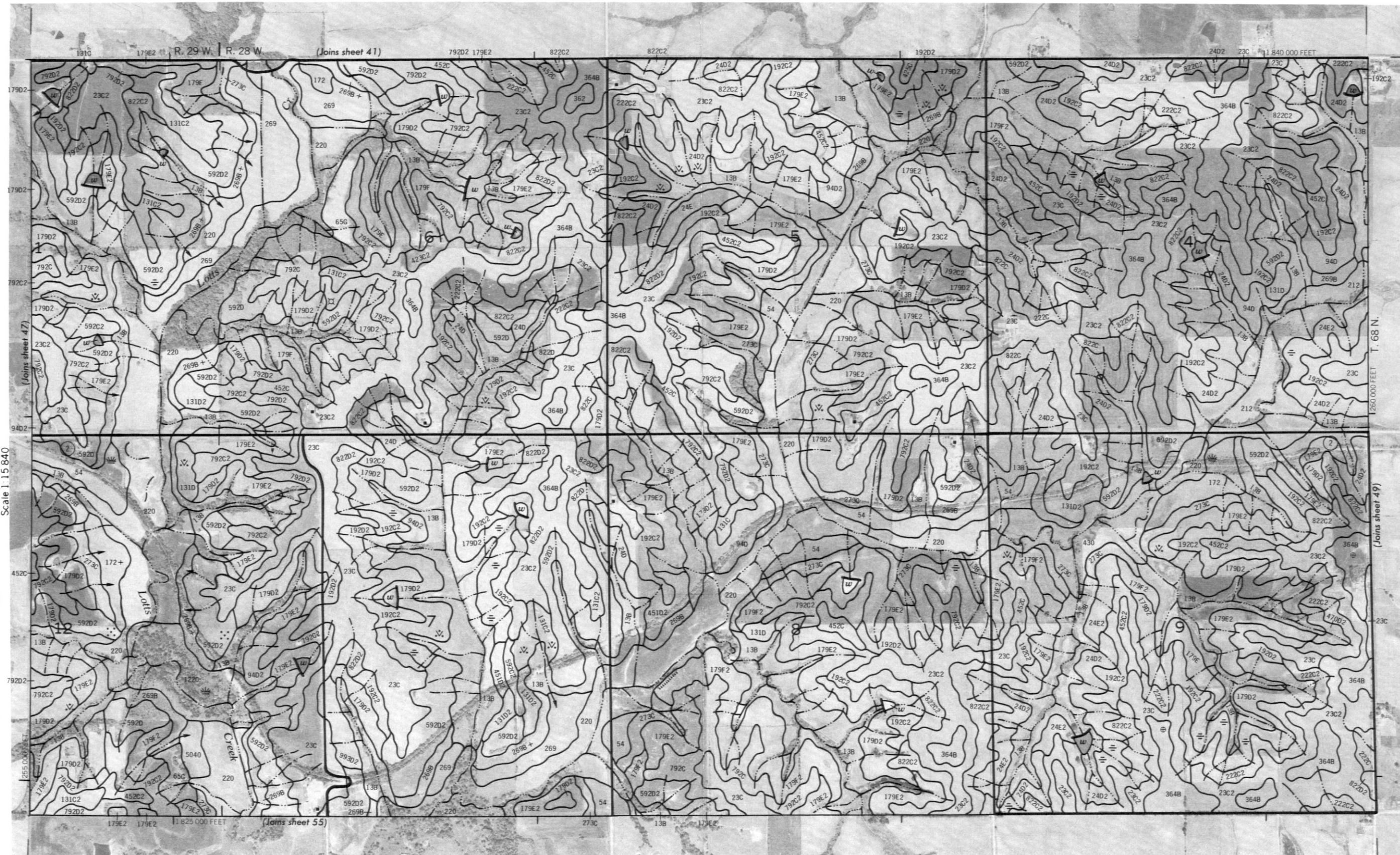
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





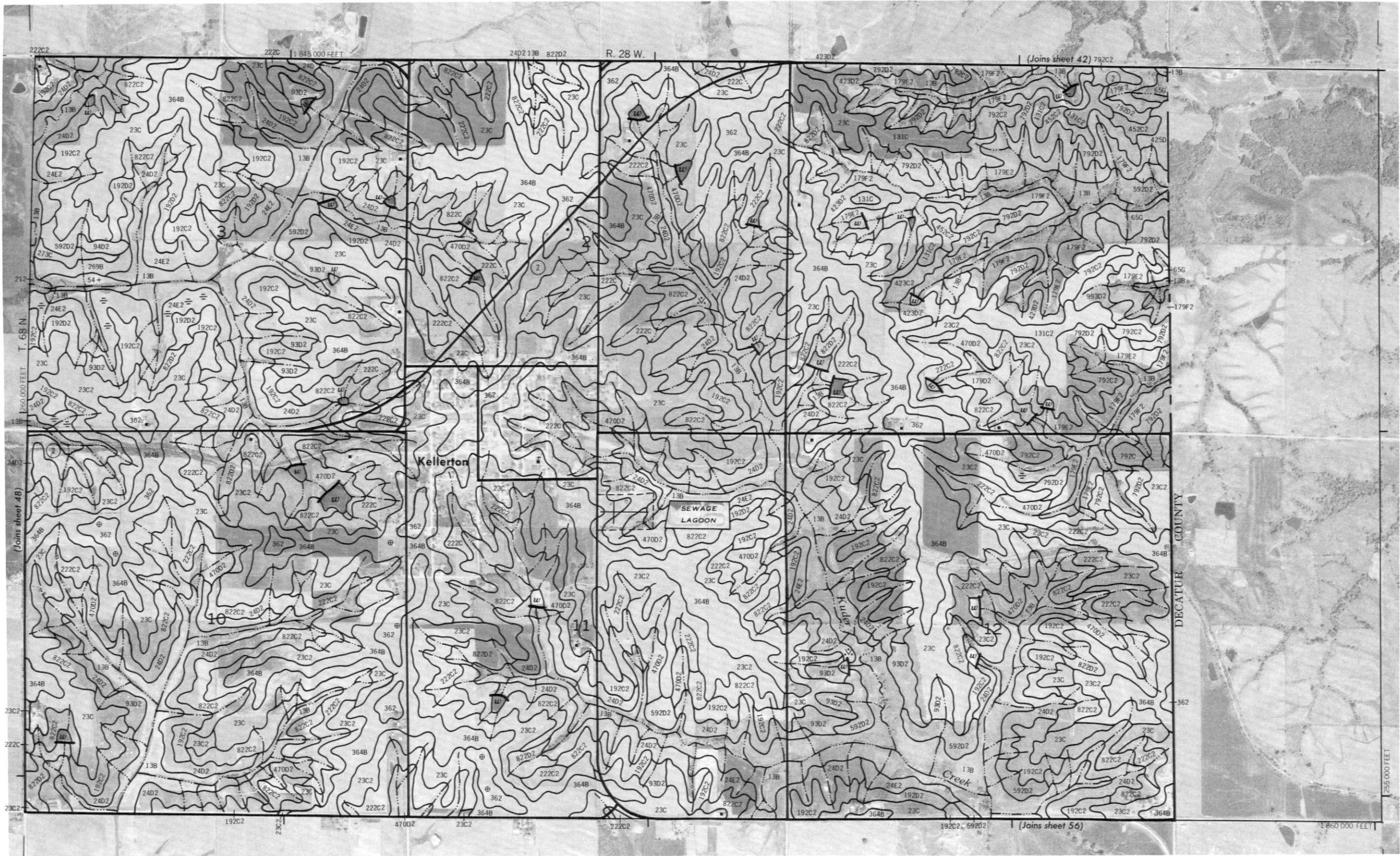
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies Coordinate grid ticks and land division corners, if shown, are approximately positioned.



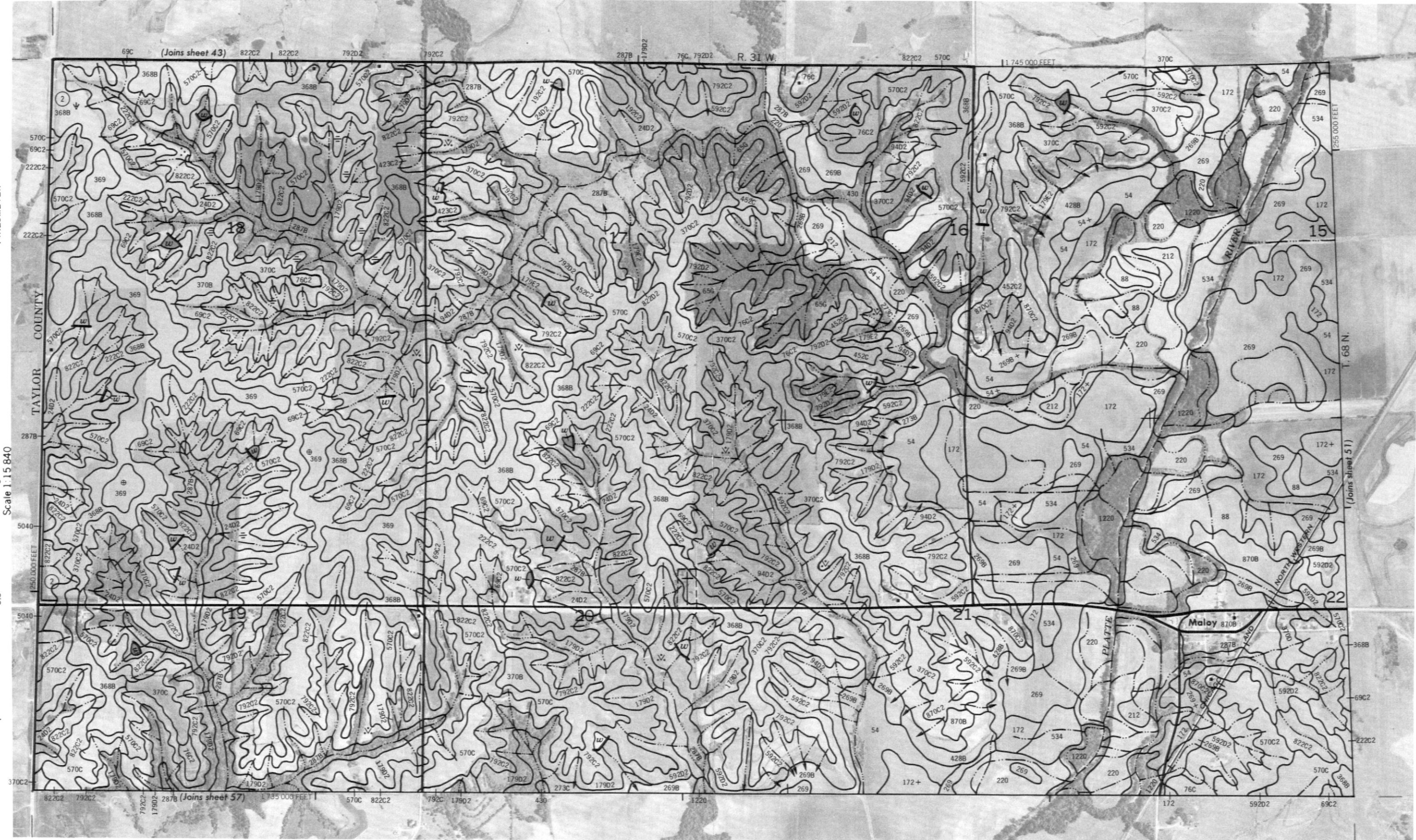


RINGGOLD COUNTY, IOWA NO. 49

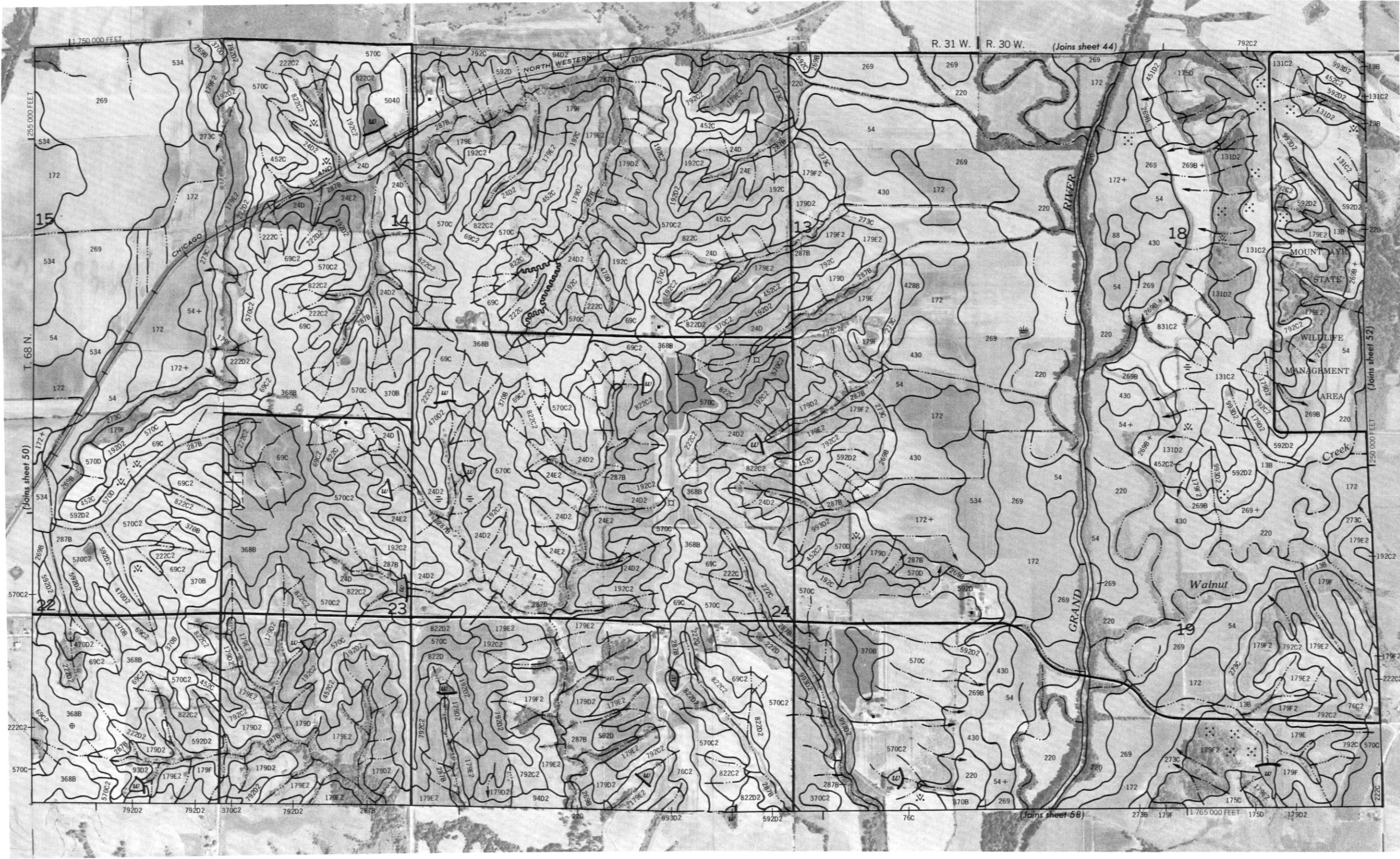
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



Scale 1:15,840



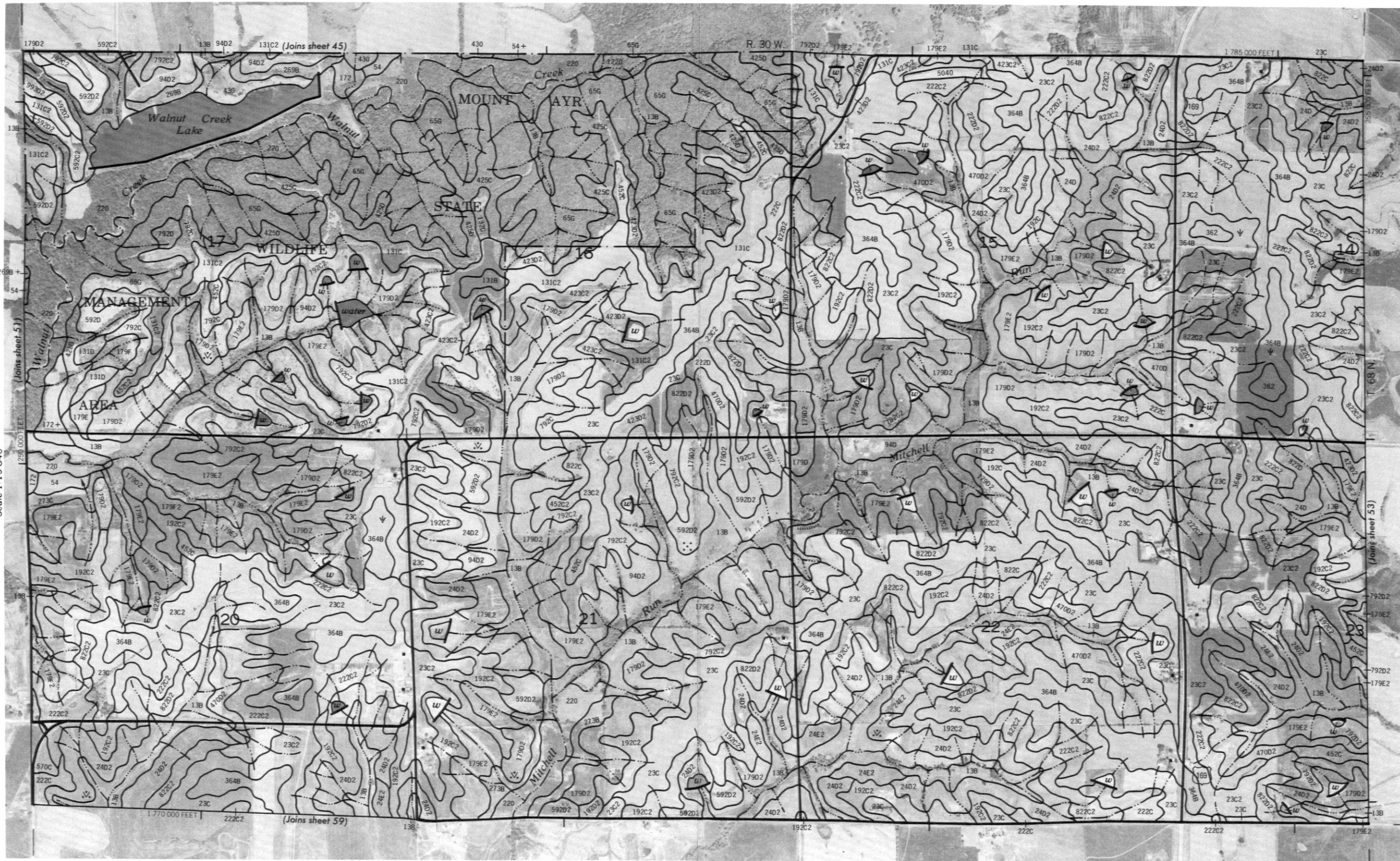
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



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Scale 1:15,840



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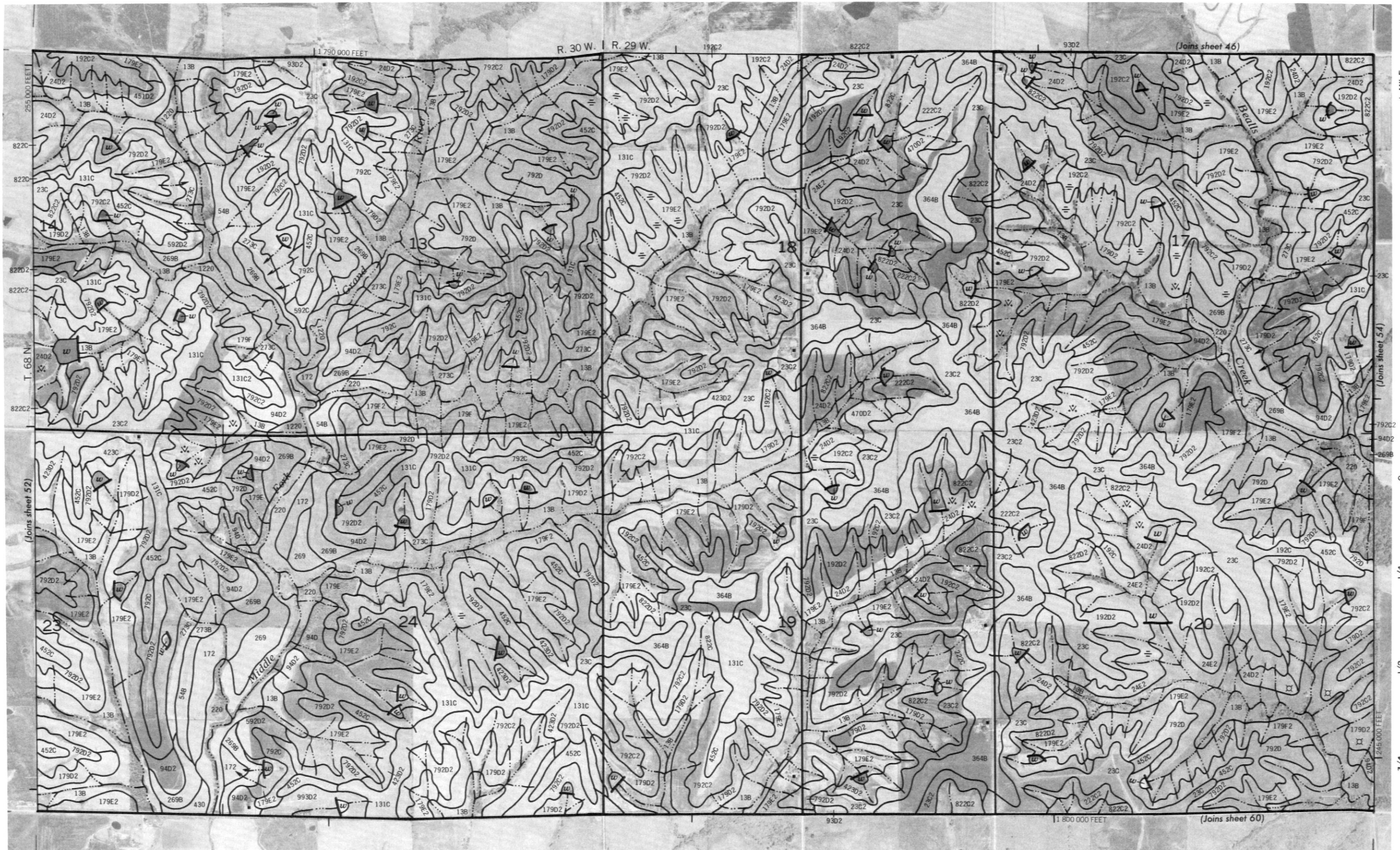
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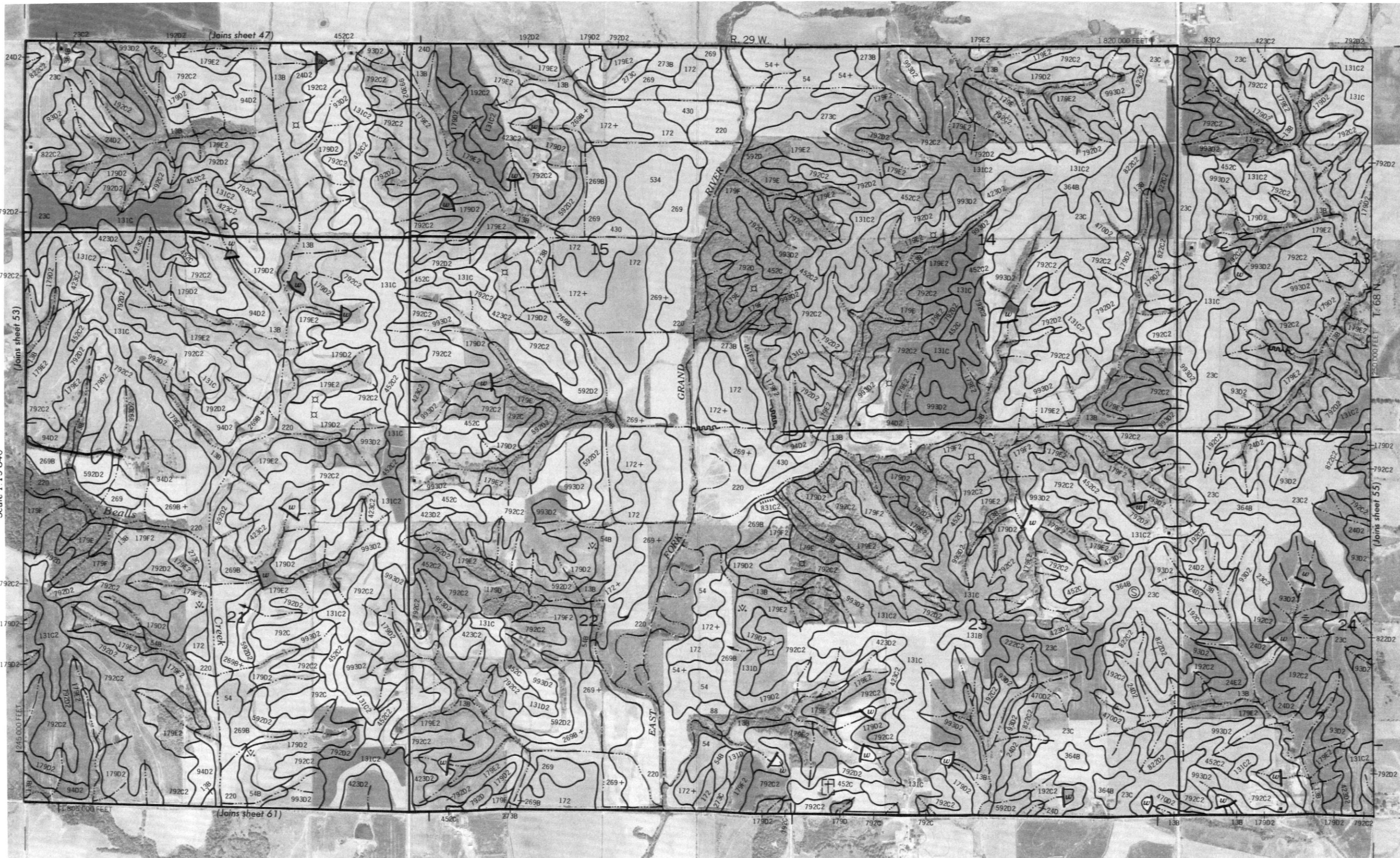
Scale 1:150

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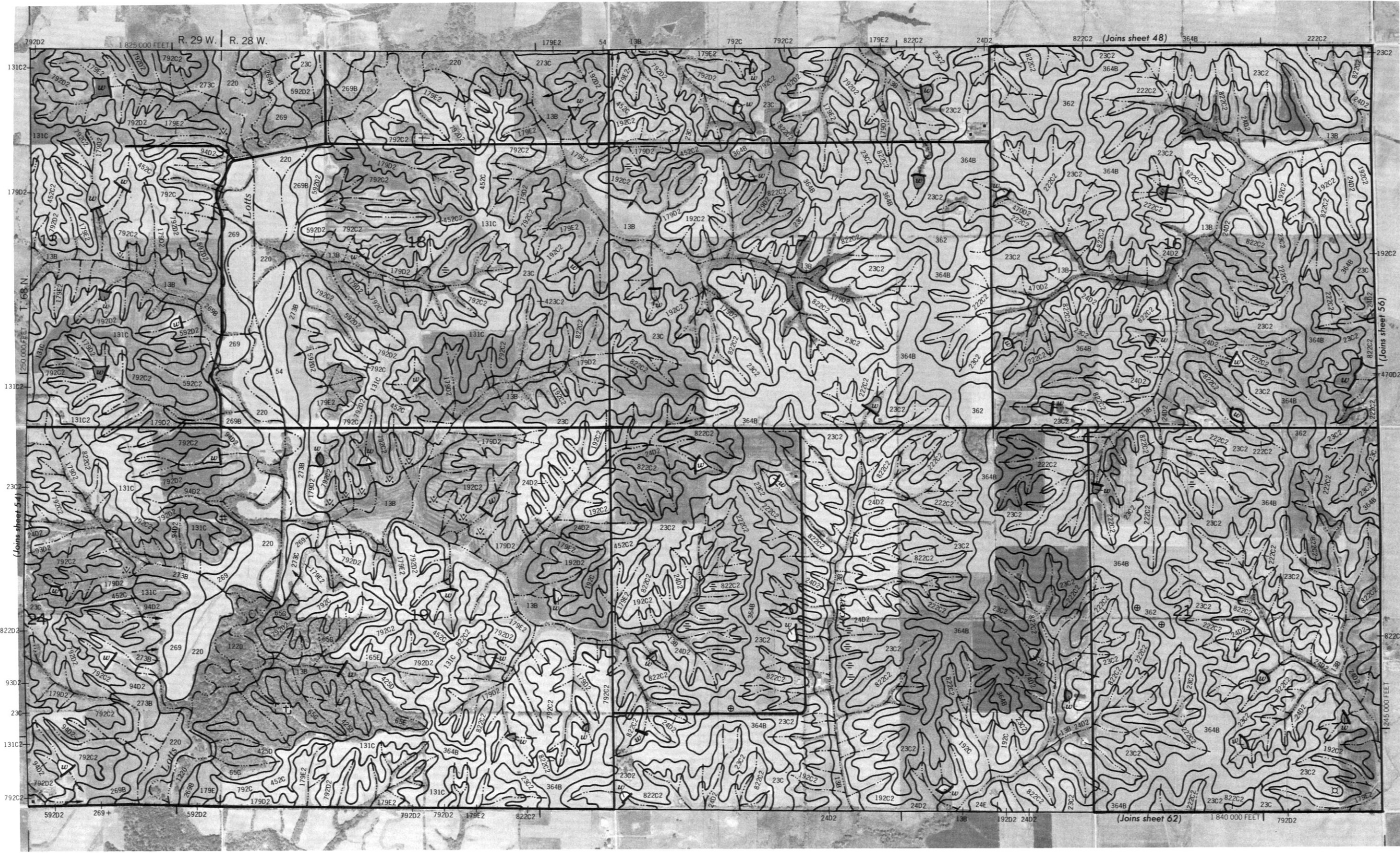
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This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

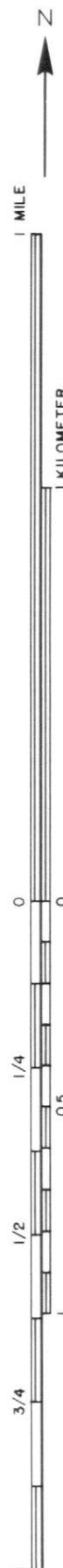


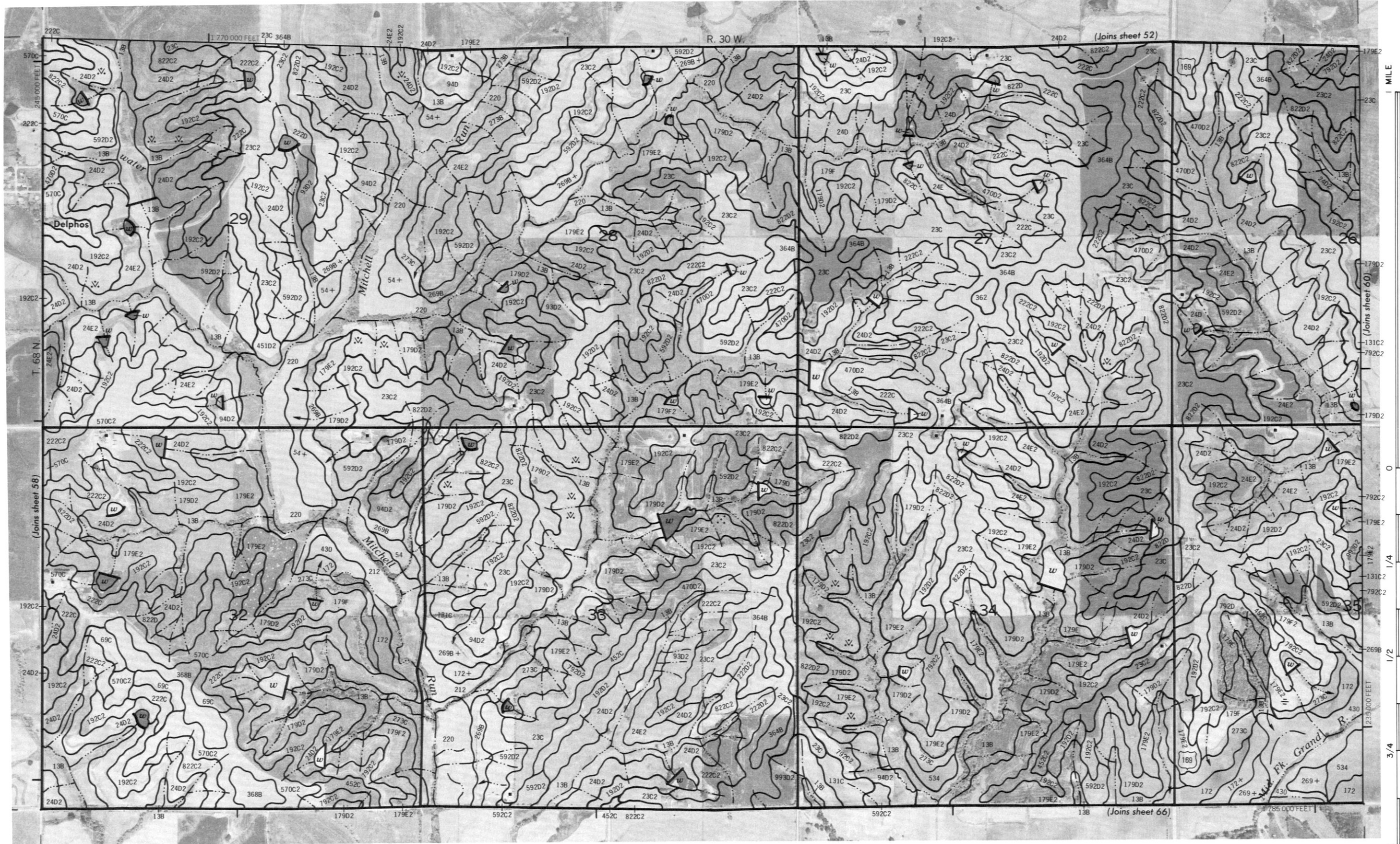


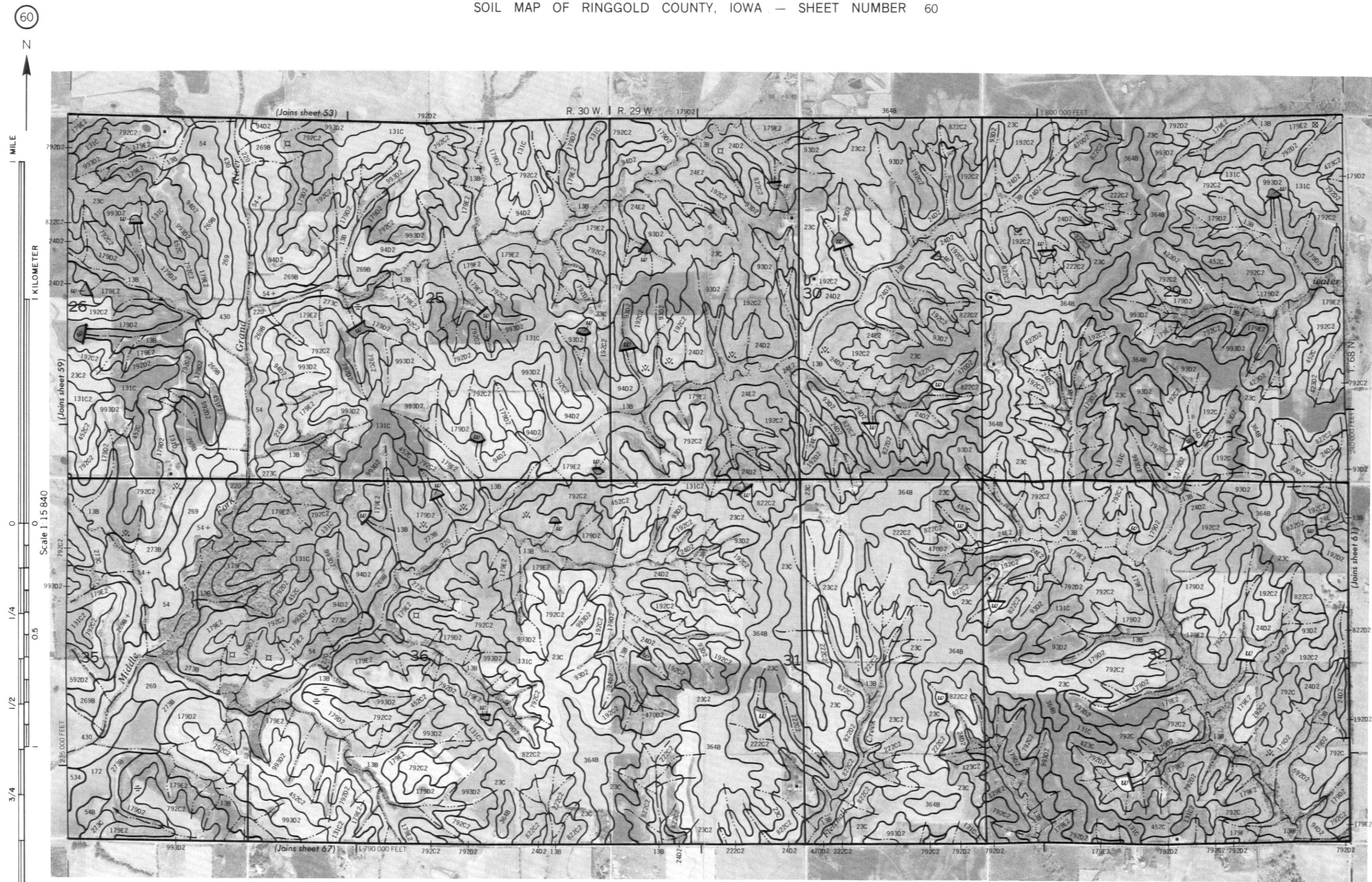
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned







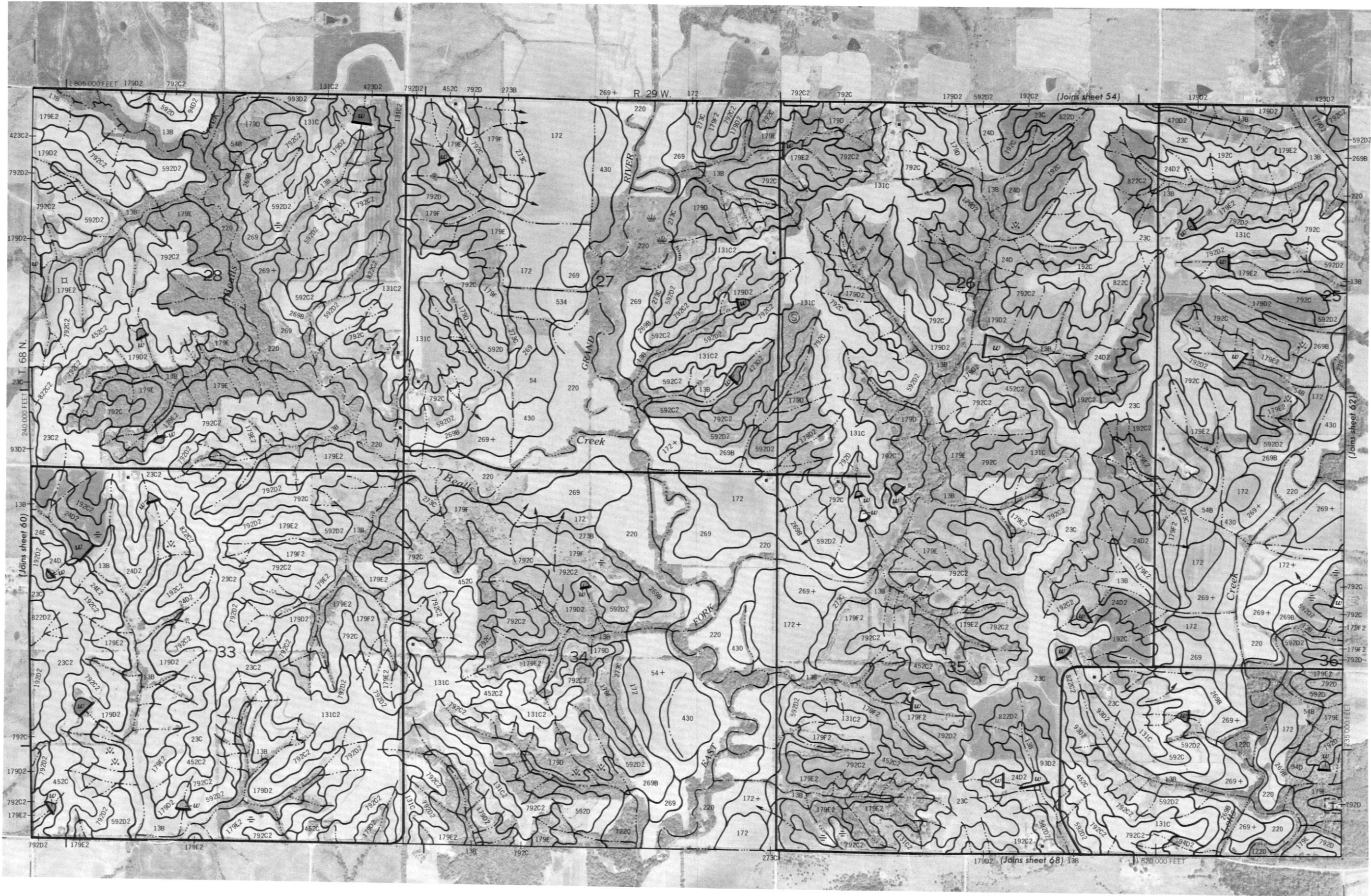




This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

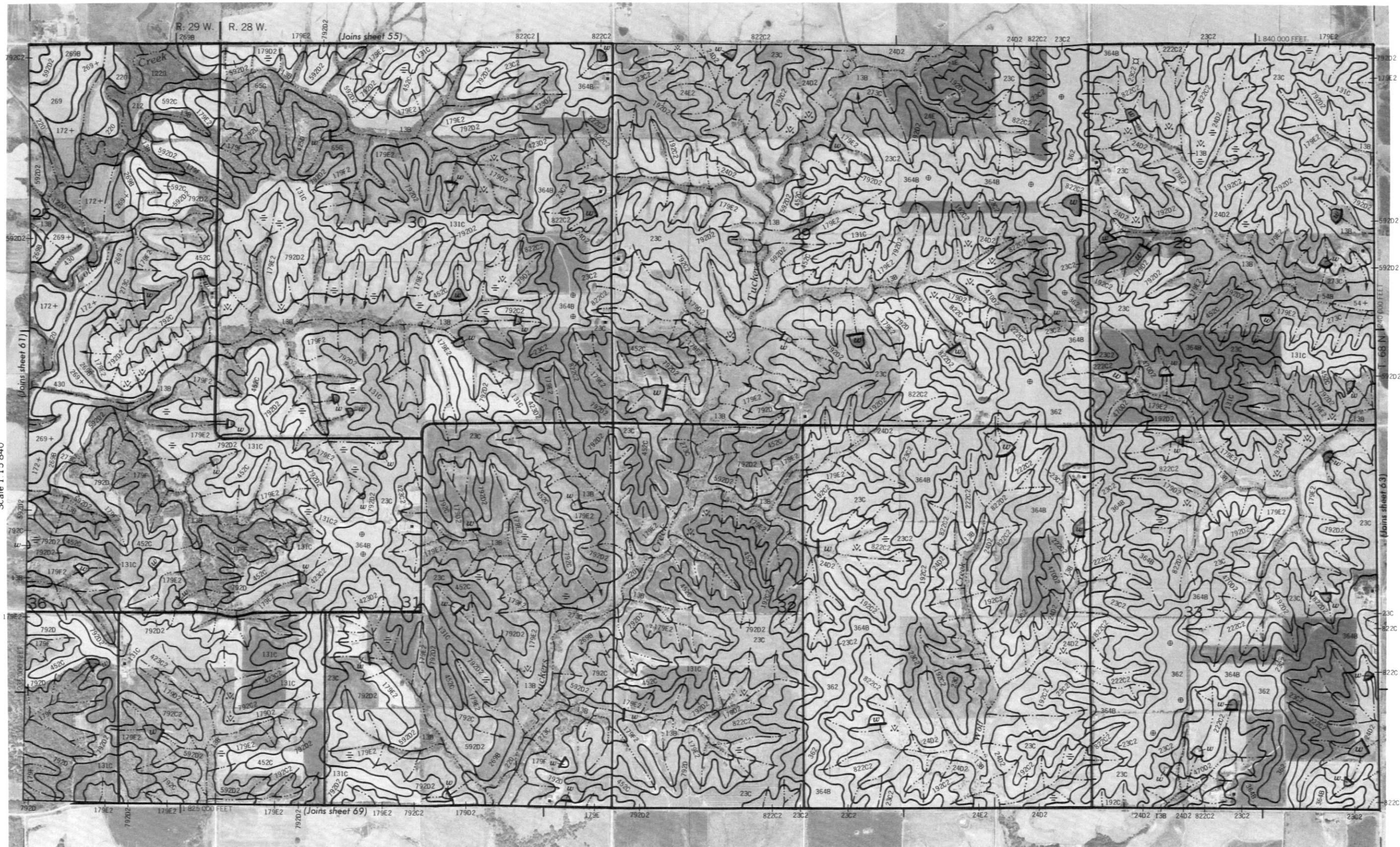
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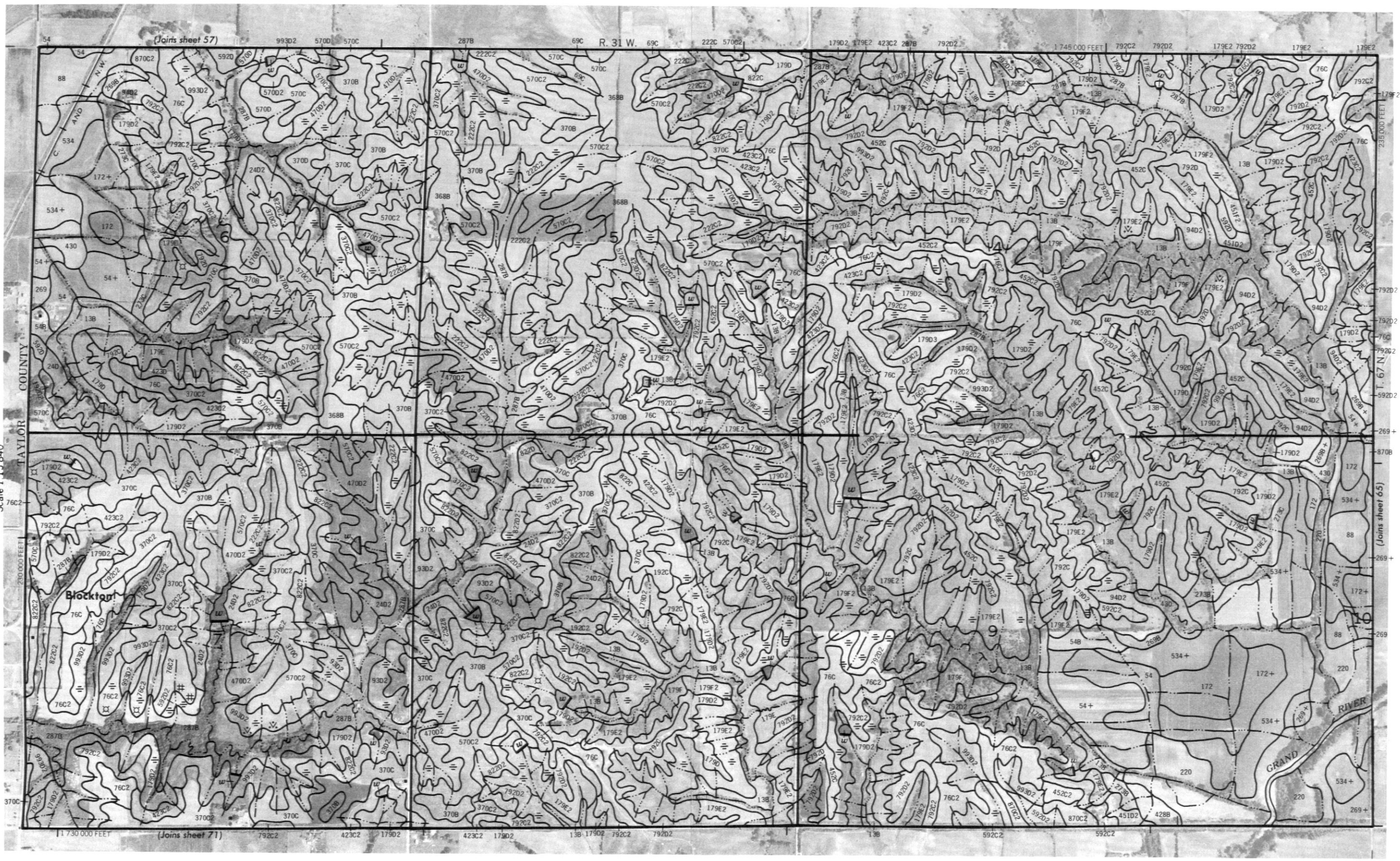


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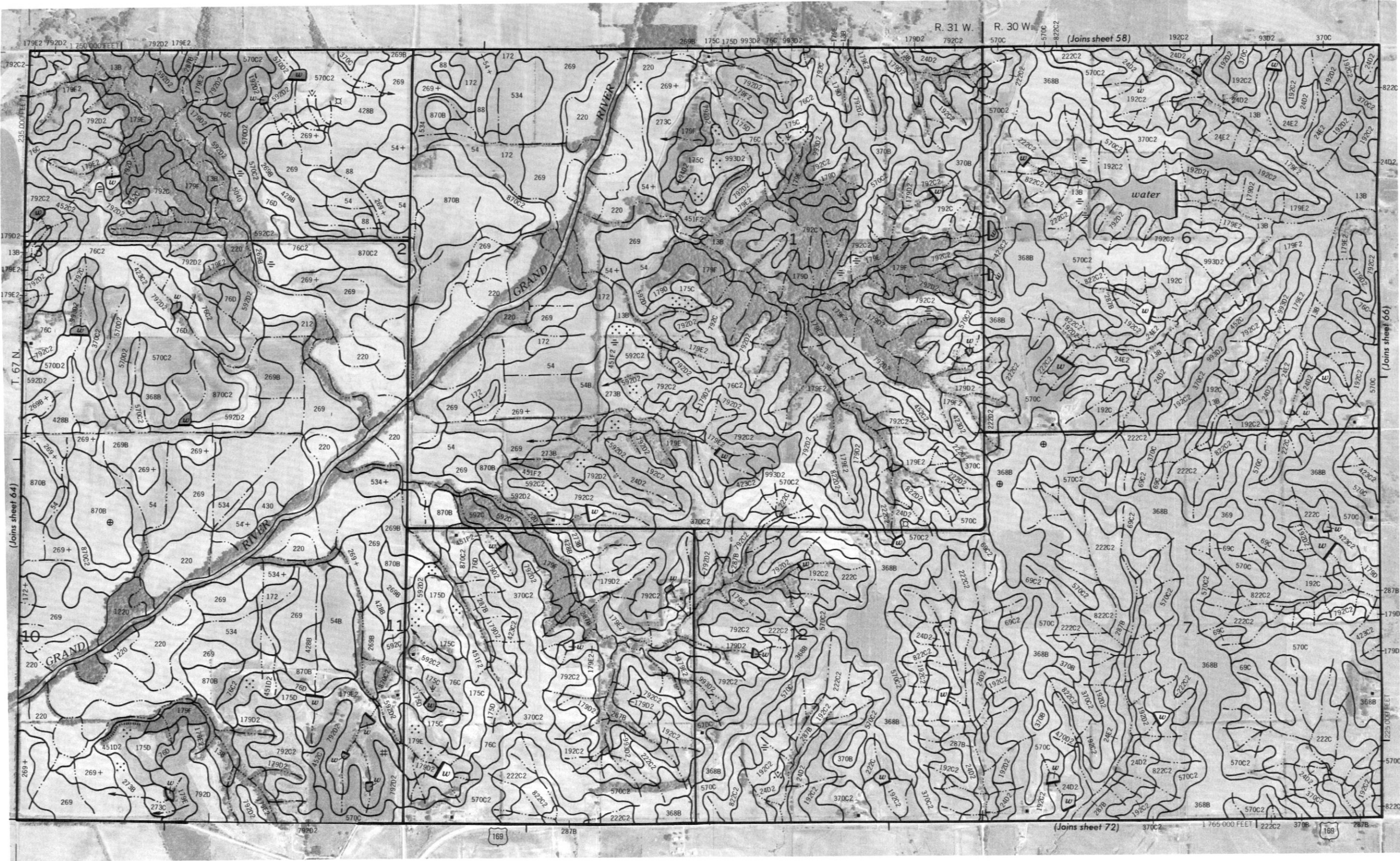
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This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Coordinate grid ticks and land division corners, if shown, are approximately positioned.



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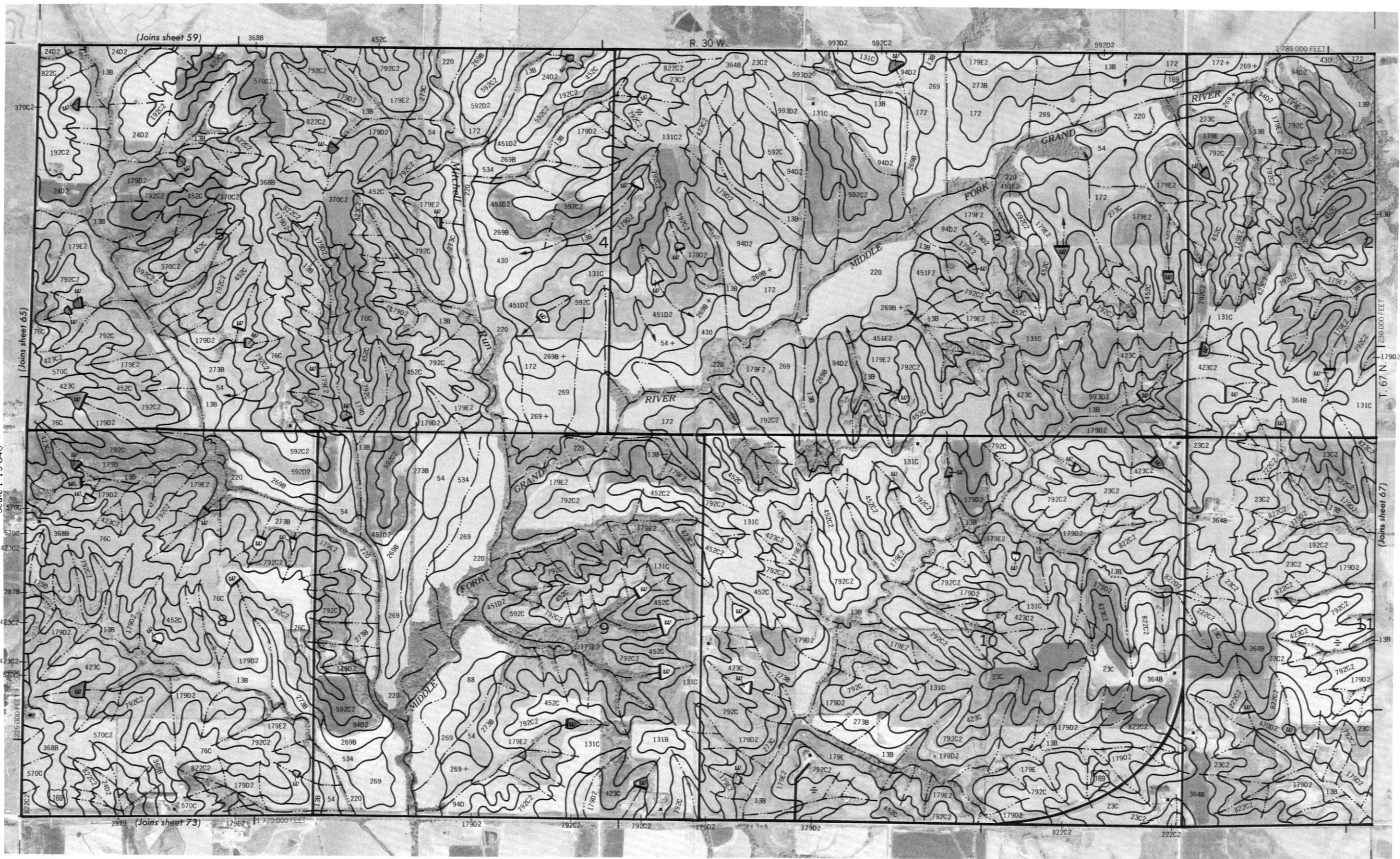
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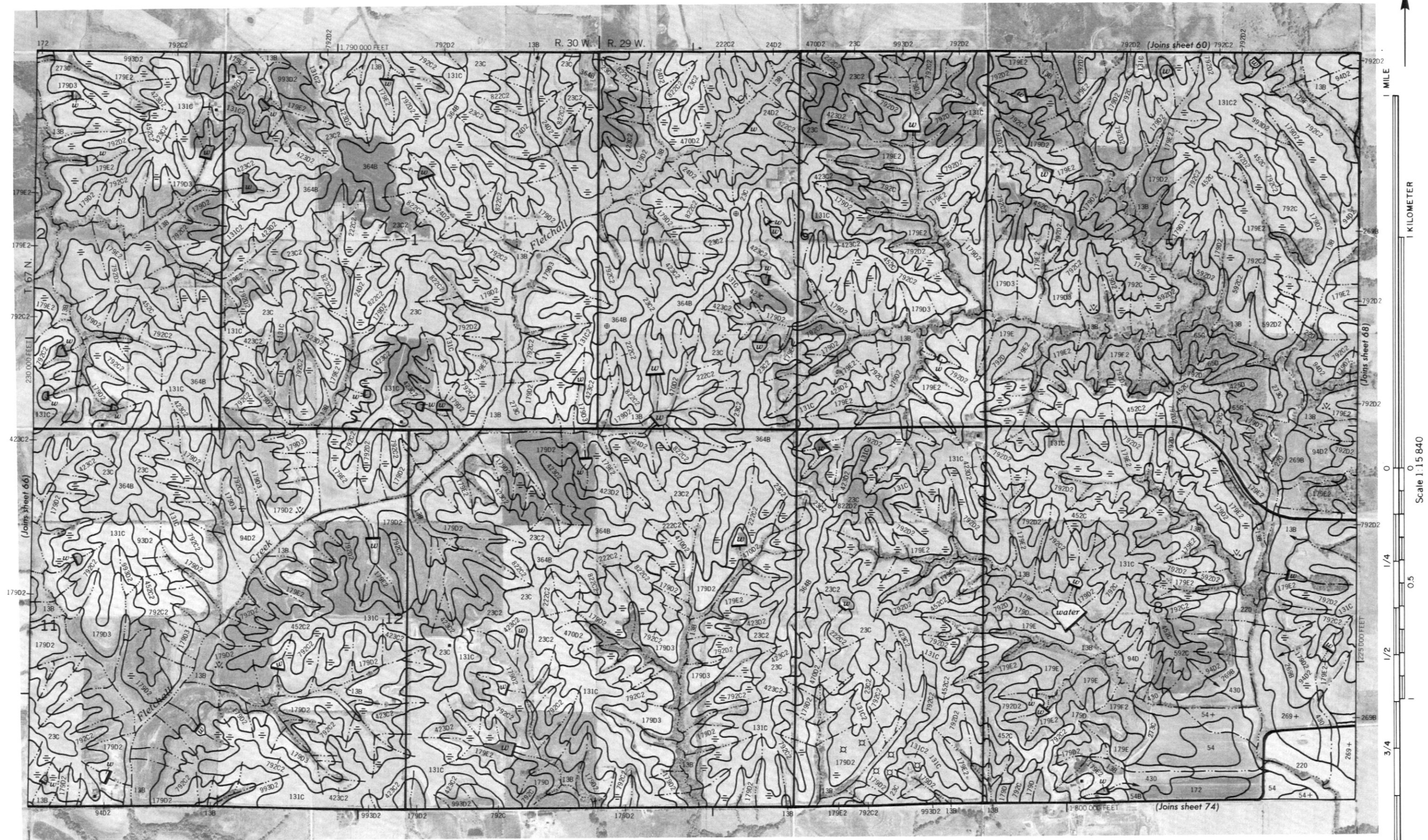
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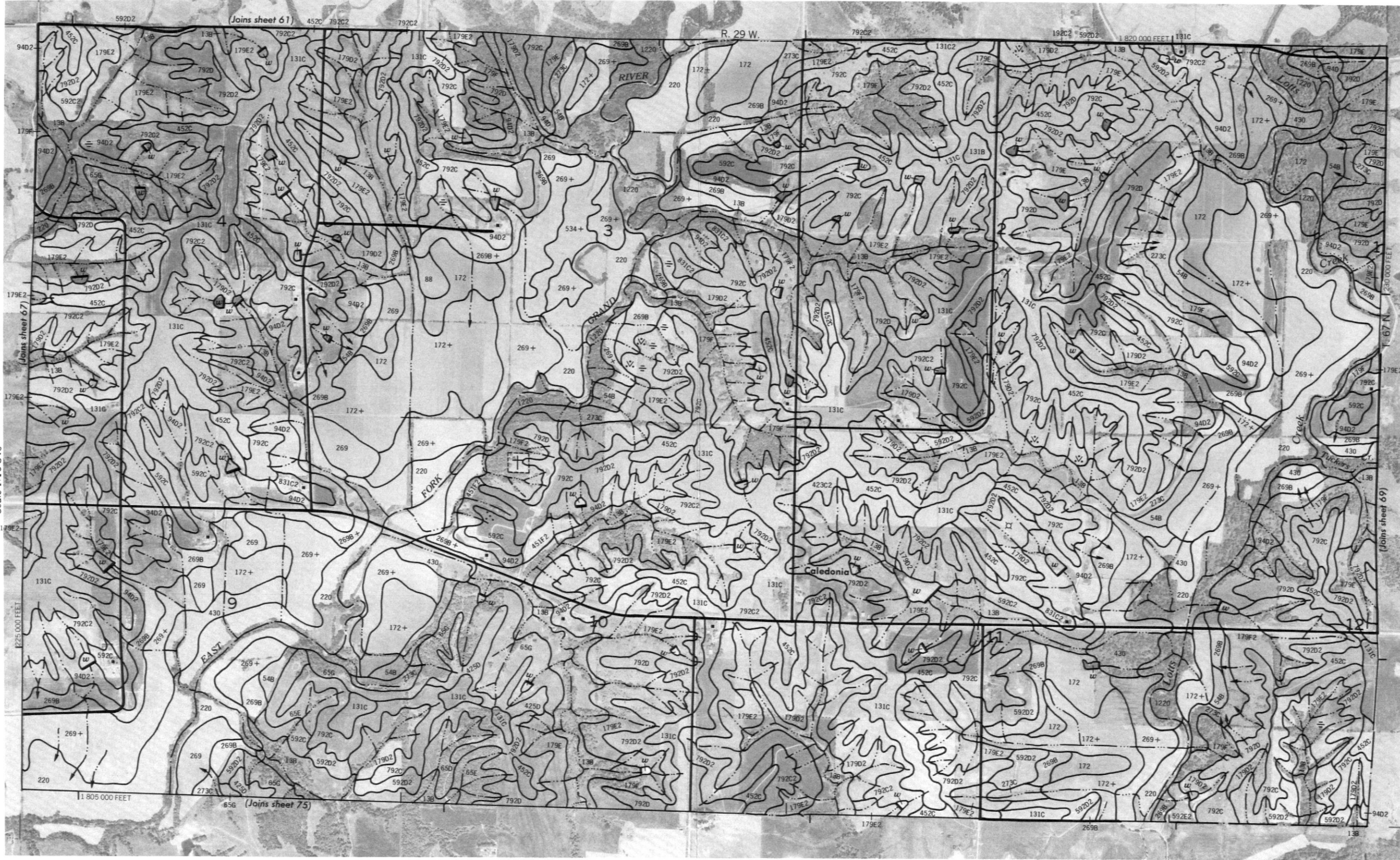
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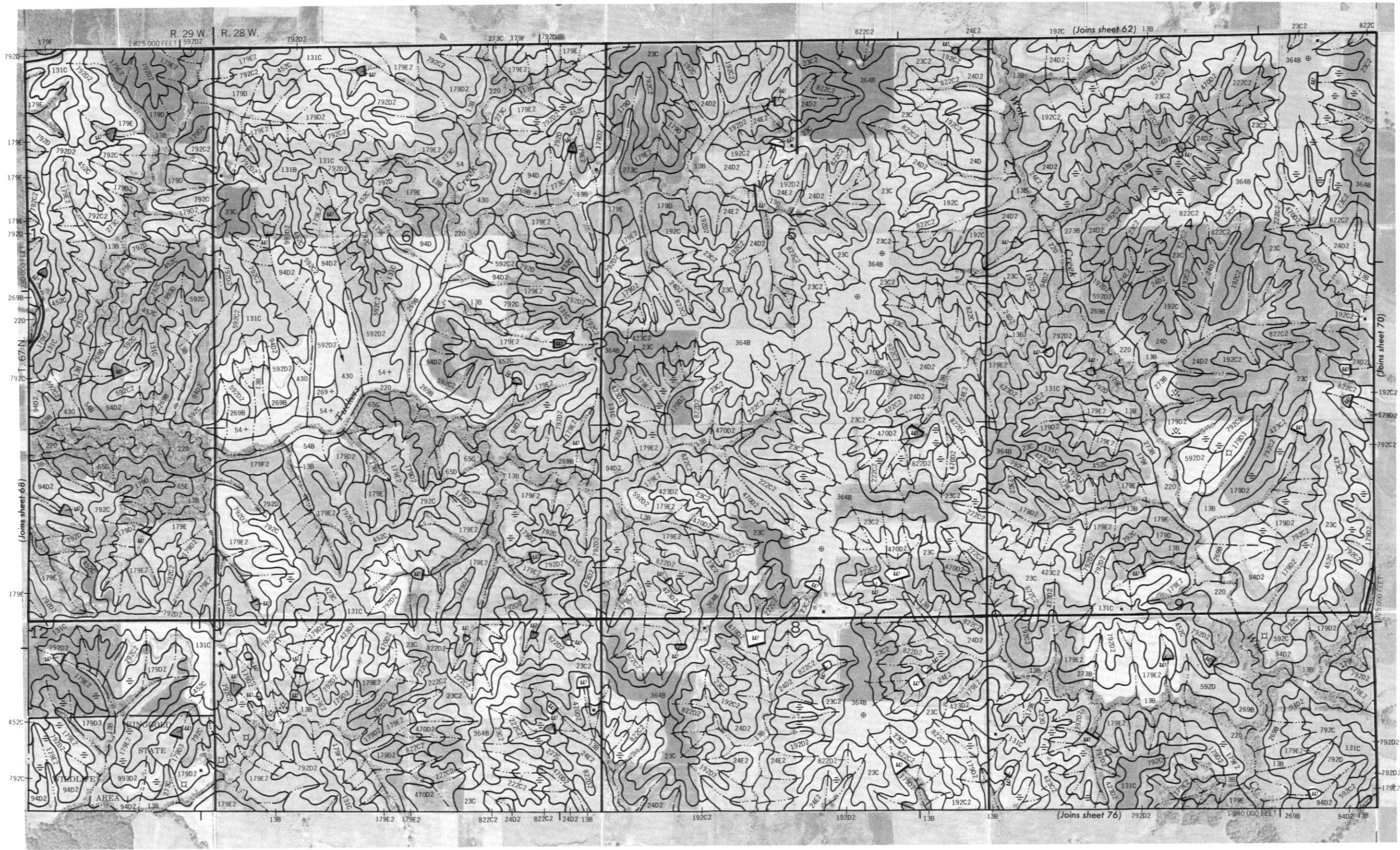
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





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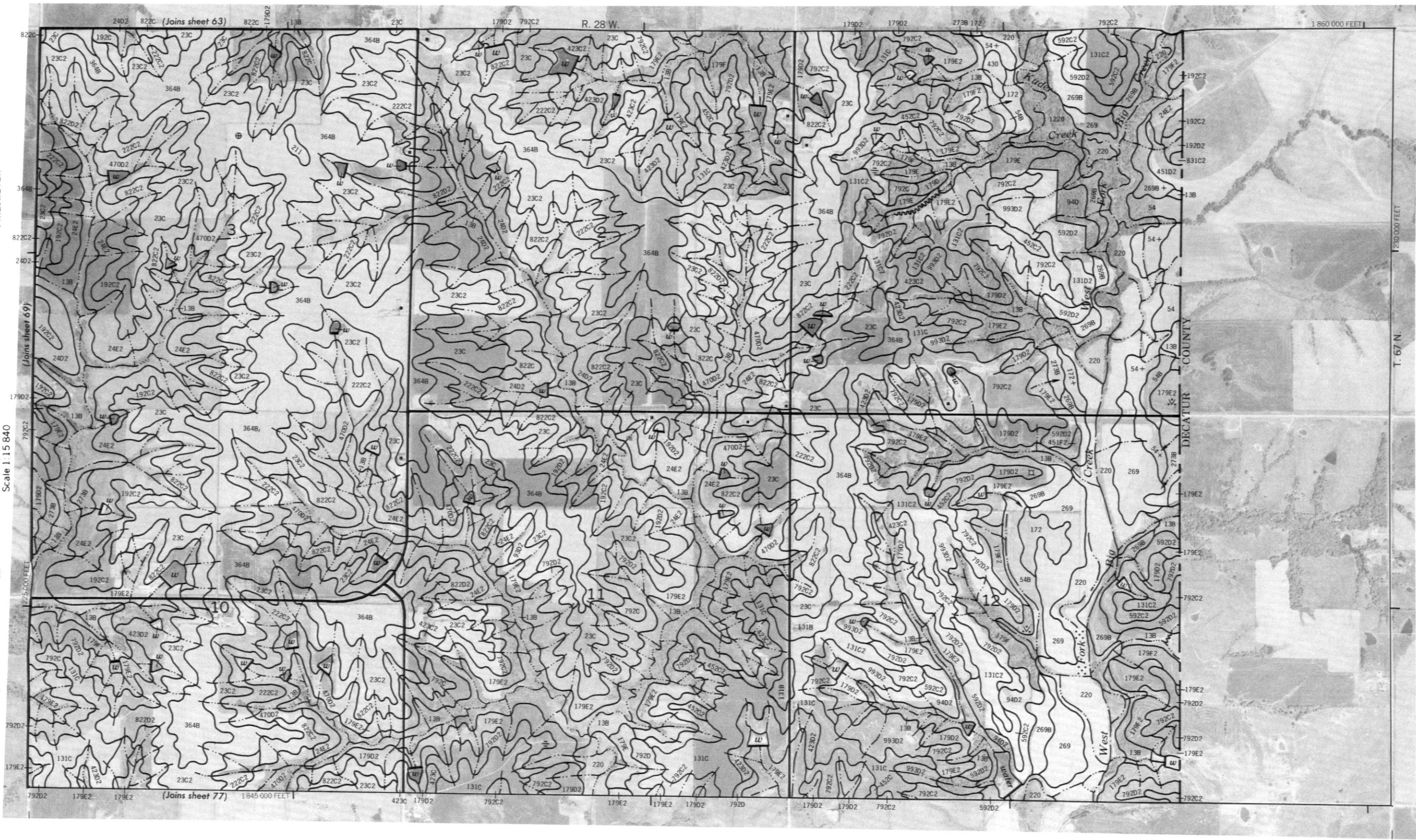
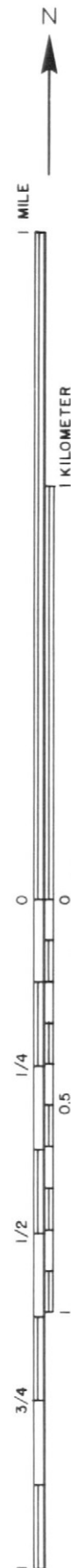
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Scale 1:15840



This soil survey map is compiled from 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



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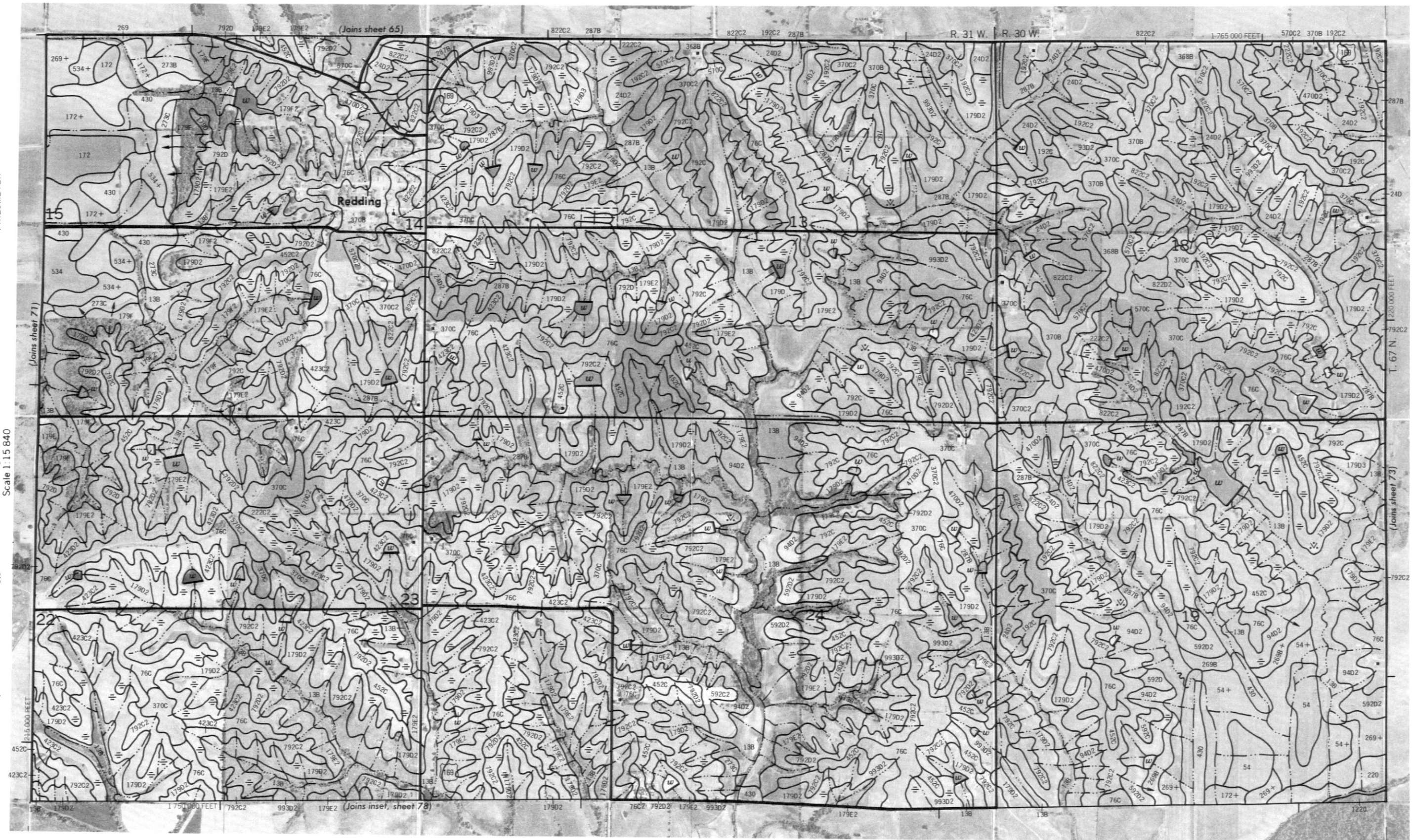
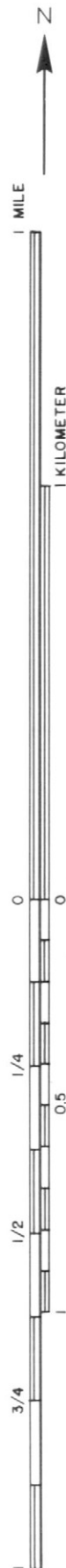
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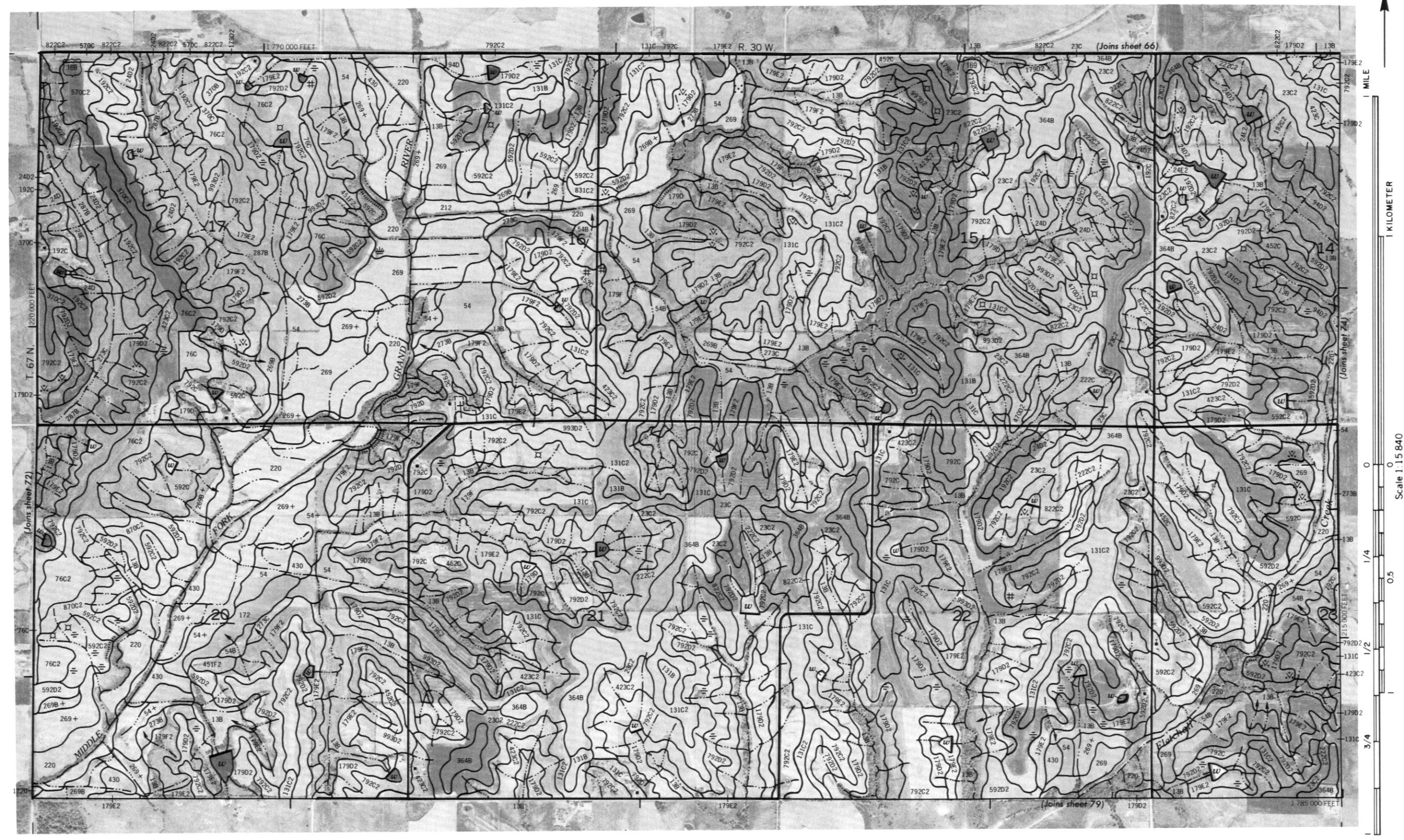
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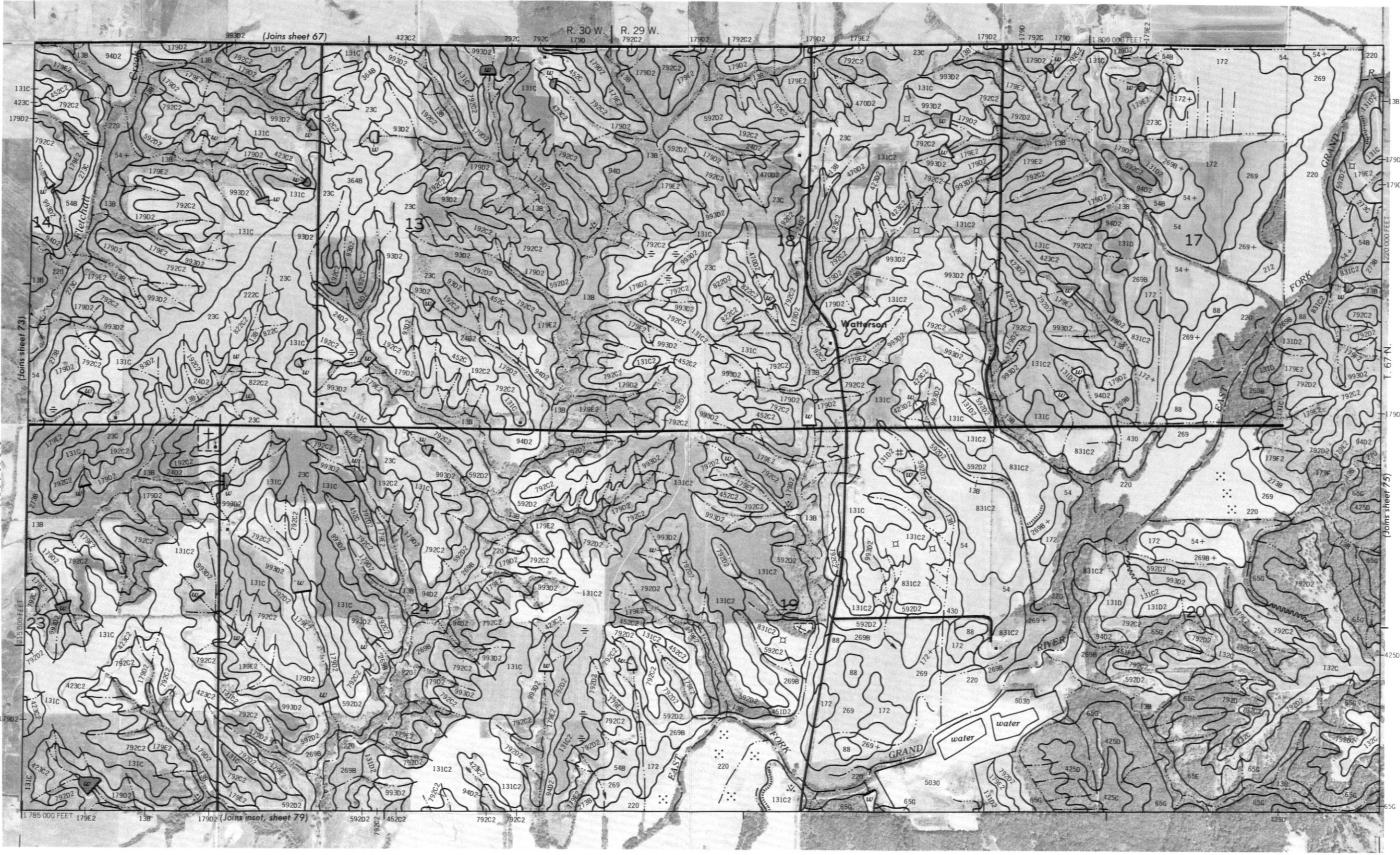
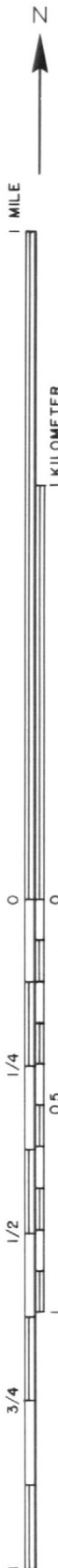
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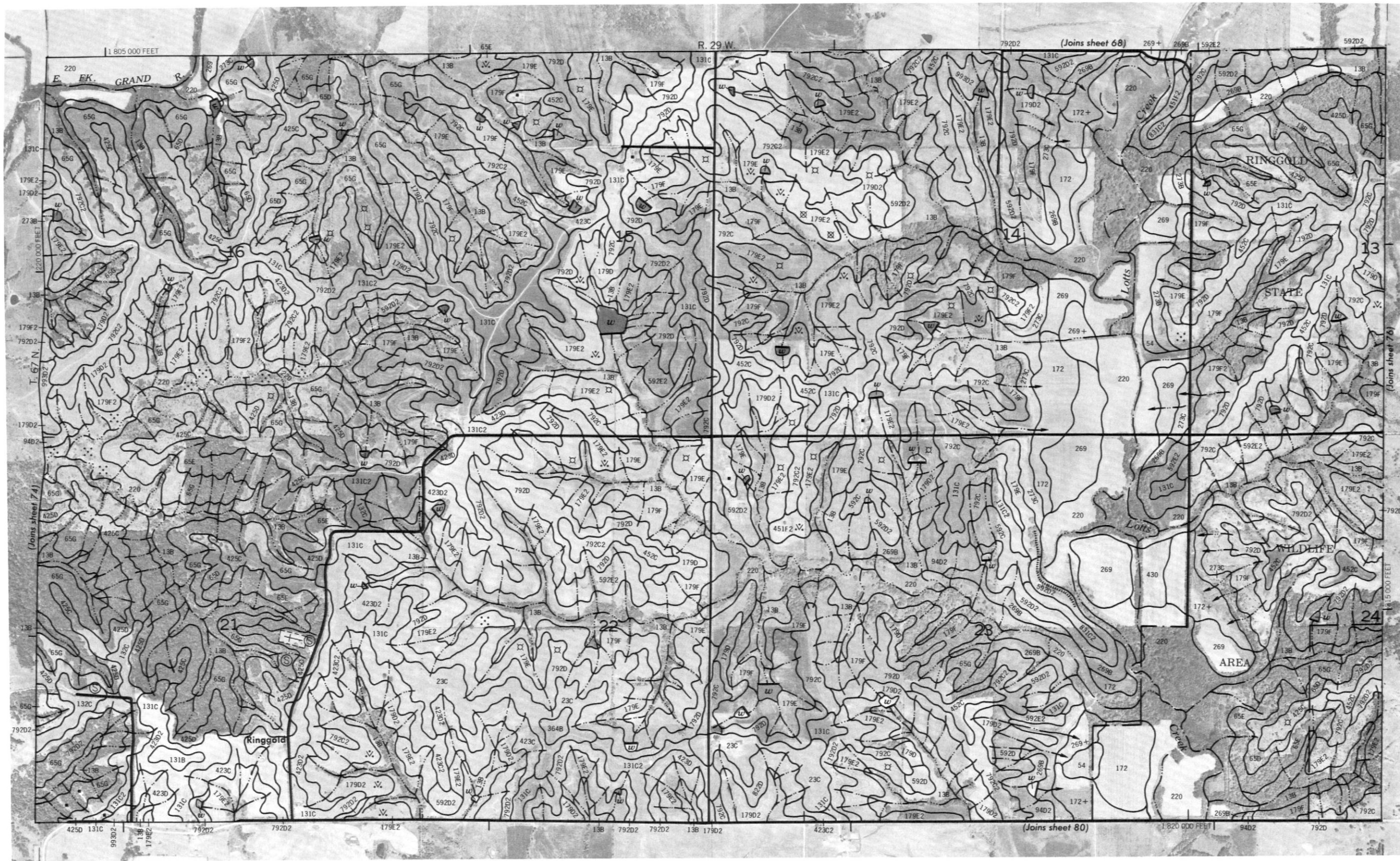


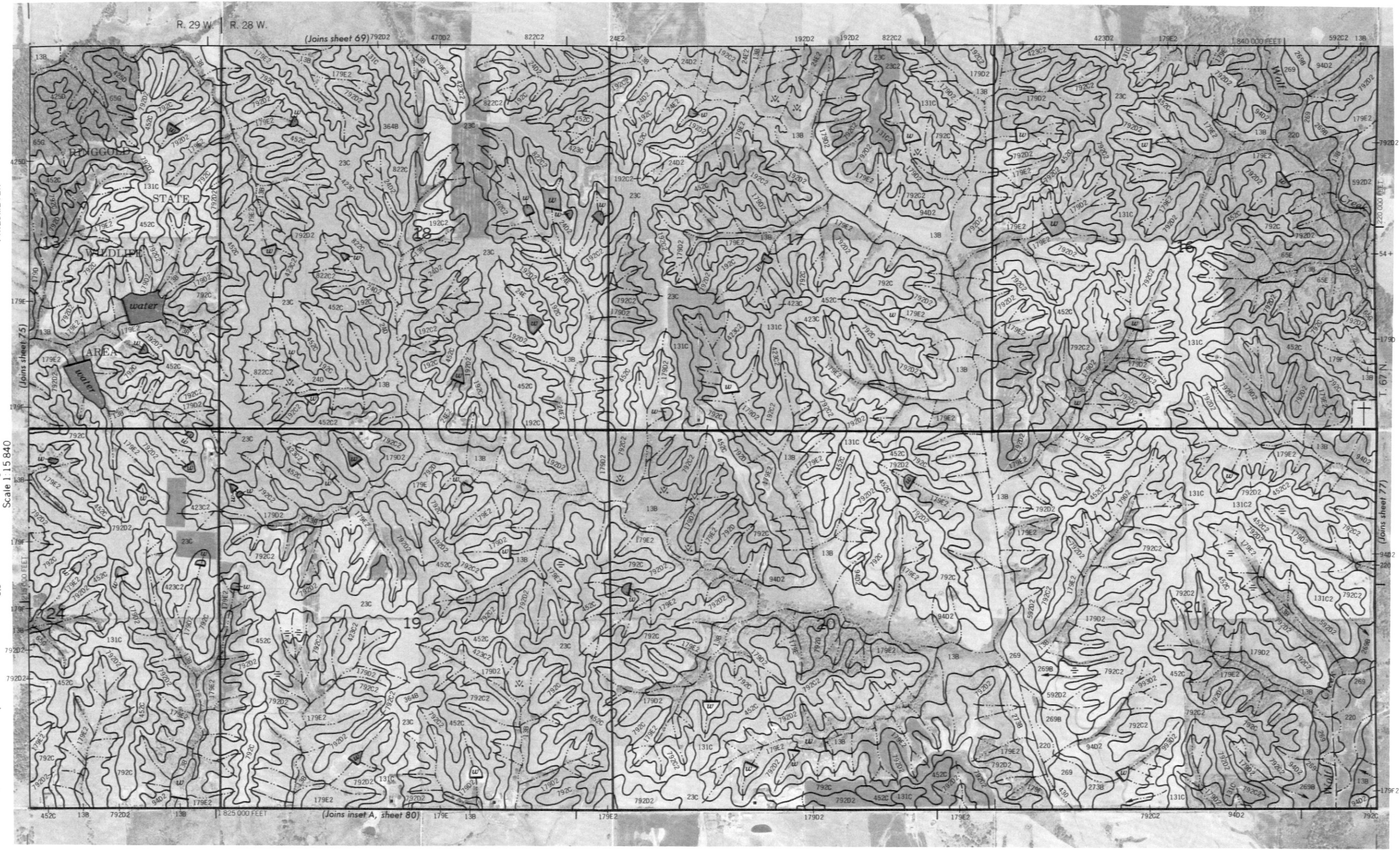
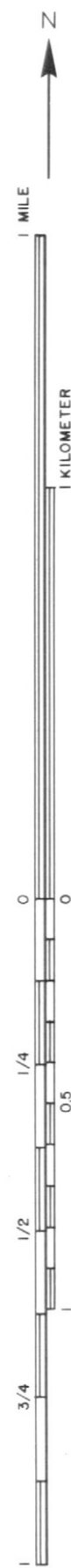
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate and ticks and land division corners, if shown, are approximately positioned.





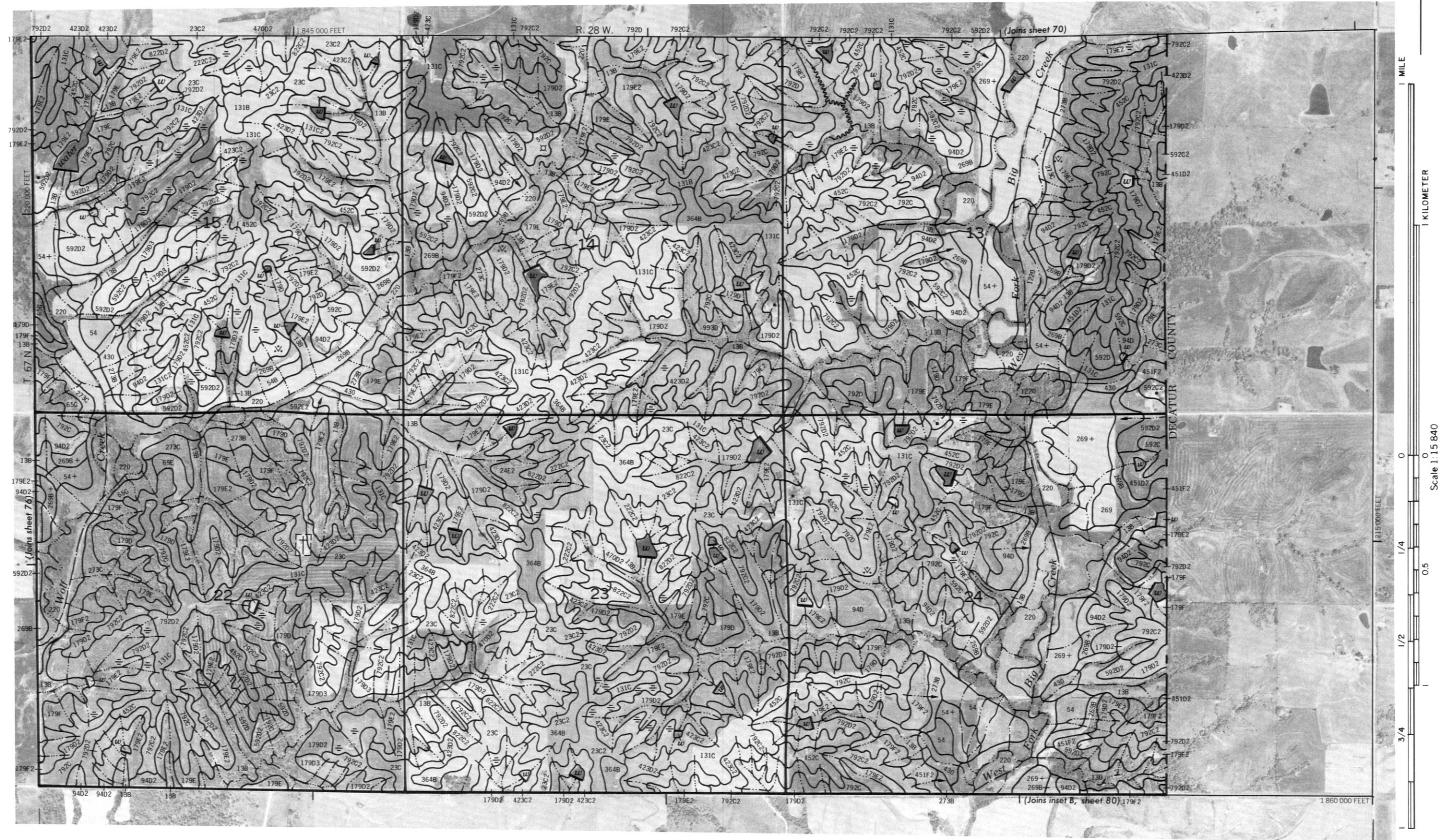
This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

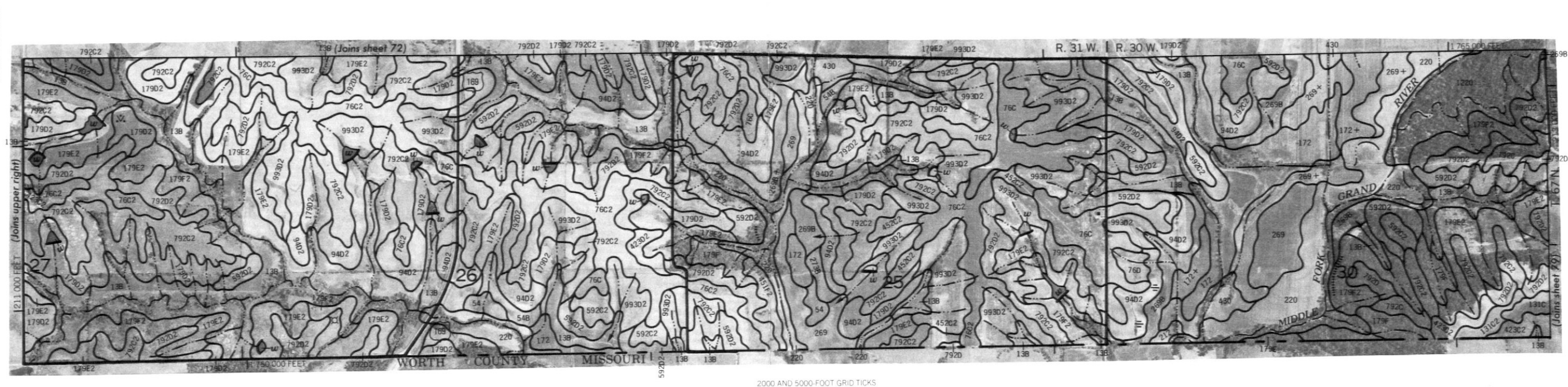




This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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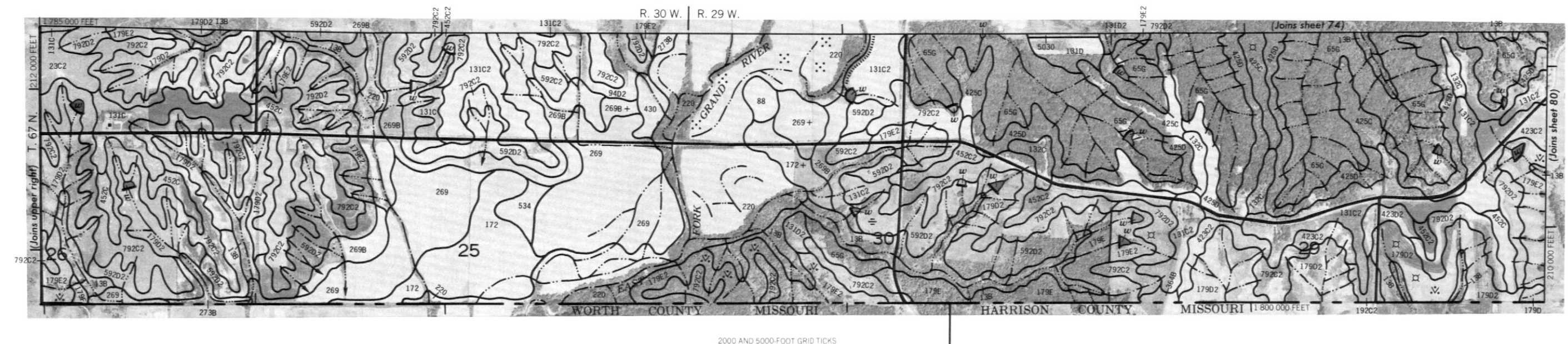
1 MILE

1 KILOMETER

Scale 1:15 840

0 1/4 1/2 3/4

This soil survey map is compiled on 1979 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





1 MILE

1 KILOMETER

Scale 1:15840

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